CITY GOVERNMENT.

[Entered as Second-Class Matter at the New York, N. Y., Post Office, August 12, 1896.]

VOL. 5. NO. 5. NEW YORK, NOVEMBER, 1898. $3 A YEAR.

AMERICAN SOCIETY MUNICIPAL IMPROVEMENTS.

The fifth annual convention of the American Society of Municipal Improvements was held at Washington, D. C., during the last week of October. The officers elected for the ensuing year are: President, N. P. Lewis, Brooklyn, N. Y.; vice-presidents, A. D. Thompson, Peoria, Ill.; R. H. Thomas, Parkersburg, W. Va., and B. H. Colby, St. Louis, Mo.; secretary, D. L. Fulton, Allegheny, Pa.; treasurer, John L. Kennedy, Nashville, Tenn.; finance committee, F. J. O'Brien, Oswego, N. Y.; F. A. Twamley, Grand Rapids, Mich., and G. S. Nichery,

NELSON P. LEWIS, PRESIDENT.

Bangor, Me. Many of the important papers and committee reports of the convention are published in full in this issue of CITY GOVERNMENT, and others will be printed in subsequent issues. The address of President Harrison Van Duyne, of Newark, N. J., in opening the convention, was as follows:

PRESIDENT VAN DUYNE'S ADDRESS.

Gentlemen of the Convention: Since the last convention of the American Society of Municipal Improvements in Nashville, Tenn., great events have occurred in this country, adding a new chapter to its history, the far-reaching effects of which we may not yet realize. We know, however, that while we have been wonderfully successful in the war with Spain and in the direct results growing out of the war, we could hardly have foreseen the importance of the events indirectly resulting from it. Dewey and Sampson and Schley have demonstrated to the world the power of the American Navy. England and America, with so many interests in common, have had much of the old bitterness of feeling removed, and above all, we have become a united people in heart as well as in name, and ready to work together for the common good of all.

The general government has had a severe experience this year with the dangers arising from assembling large bodies of men together, and has found that the best possible sanitary arrangements must be made to protect their health.

People crowd into our cities, and the members of this Society, representing as they do the governing and working power of so many cities, have a special responsibility resting upon them.

Are the streets and avenues of your city in good condition, and are they kept clean? Is your city properly sewered? and have you a water supply uncontaminated and kept in such condition that your health and that of your families is not endangered by drinking it? In answering these questions we realize how much the health and comfort of the hundreds of thousands of people we represent is placed in our care.

We come together once a year to listen to the reading of carefully prepared papers by some of our members on the various subjects relating to city improvements, and in the discussions which follow the actual experience of the different cities is clearly brought out, but in addition to that the visits made by us each year to a different one of our larger cities, enabling us to study on the ground the best work done in each, give us all an experience and training that must be of great advantage to the city we represent.

Our first meeting was held in Buffalo, probably the first city in this country to decide that smoothly paved and clean streets were a necessity; and its citizens and officials must have had the courage of their convictions to show by their example what a progressive city could do.

Three years ago we met in Cincinnati, an ideal convention city, built on its seven hills, its inclined planes and stationary engines making easy access to their very top. Miles of finely paved streets and its extensive sewer construction showed it to be another of our very progressive cities, and in its hospitality it could not easily be excelled.

Two years ago we were in Chicago, that marvel of the West, with its beautiful parks and fine suburban drives; to improve its sewer system it has not hesitated to change the course of a river, and some day it will be at the head of navigation of the Mississippi.

Last year we were at Nashville, Tenn., a city with energy enough to successfully carry on a great Exposition and which will easily, in its improvements, rank as one of the foremost cities of the South, and this year we come to the National Capital, the city in which we all feel a personal interest and a special pride, and in passing through its finely paved streets and avenues and in admiring its beautiful parks and public grounds we fully realize that thoroughly trained and conscientious men are at the head of the public work in Washington.

At the convention held last year our committee on street paving recommended among other things that, where a contractor was required to guarantee his work for a term of years, especially in asphalt pavement, the condition of the pavement at the end of the term should be specifically stated. The city of Newark this year partly adopted these suggestions, and instead of paving with asphalt under specifications calling for a five-year guarantee with indefinite requirements, now requires a ten-

year guarantee under bonds given by a responsible trust company, and the exact condition in which the pavement is to be at the end of that term in order to be accepted is stated. Under the old specifications, for several years only Trinidad Lake asphalt was used; last year the bidders were limited to four different kinds, and this year, under the more severe and definite specifications, the door was thrown wide open to all asphalts. Any responsible company or individual giving approved bonds is given the contract, provided the bid is the lowest.

The first asphalt laid in Newark was in the year 1890, and from that time until 1894 it cost about $2.85 per yard. This was laid by the Barber Asphalt Company, and virtually without competition; last year the price got down to $2.35 per yard, and this year, with the ten-year guarantee, but open to all, the price has been about $1.50 per yard. The city, however, agrees to pay in addition to that amount 25 cents per yard for the second term of five years for maintenance and repairs.

We have also required this year a five-year guarantee on oblong granite block pavement; notwithstanding which the price has been reduced from about $2.50 per yard in 1893 and 1894 to $1.50 per yard this year when laid on sand, and in like proportion when laid in concrete. Perhaps I should add that New York City, only nine miles away, stopped almost entirely its paving work this year, and that may have helped to reduce the price to the neighboring cities.

In all our progressive cities, and we all want to be considered progressive, the conditions are now entirely different from fifteen years ago. Even Washington, at that time, or a little earlier, had an unenviable reputation for the condition of its streets, and a number of other cities gloried in their cobblestone pavements.

But the great advance made during the last few years in city development has taken a large amount of money, the annual outlay for expenses has been greatly increased, municipal bonds are becoming a burden; and as a natural result there is such an increase in the tax rate as to cause alarm to many citizens.

During this same time in all our cities a wonderful advance has also taken place in the value of the franchises which have been given to so many companies to use the public streets to carry on their business.

These franchises are worth nearly as much as the land fronting on the streets through which their grants and privileges extend. They have a recognized value to buy and sell, and their earnings and dividends bear out that value; but when it comes to the valuation on which they pay taxes there is a wonderful drop, and the result is that they bear only a small part of the public burdens that properly belong to them, and the tax burdens of others are proportionally increased. I know of no reason why, according to the true value of these properties, they should not contribute their share to the support of the public schools, to the cost of maintaining our courts, and all the other expenses of city and state government, the same as other property.

True, in nearly all cases these franchises were given away as if they had no value, but is that any reason why, after their enormous value is fully established, they should not be treated as other property and annually contribute their full share to the tax collector?

Beyond our churches and schools and charitable institutions, we want no favored class, and our influence should be exerted to see that all property stands equally before the law.

In conclusion, I wish again to thank the members of this Society, for myself, and on behalf of the city of Newark, which I am privileged to partly represent, for the honor of being chosen as president, and I trust this convention will be a source of great profit to us all.

Felix L. Decarie, inventor of the Decarie garbage incinerator, heard the remarks of Dr. Woodward, as reported in the following article, and claims that all the obstacles to successful garbage cremation pointed out by the doctor may be surmounted by the use of his invention. Mr. Decarie will reply to Dr. Woodward's address in the next issue of this paper.

GARBAGE DISPOSAL.

[EDITOR'S NOTE.—Following is published a paper prepared by Arthur R. Reynolds, M. D., Commissioner of Health of Chicago, and read at the recent convention of the American Society of Municipal Improvements; also a full report of the remarks of Dr. W. C. Woodward, Health Officer of the District of Columbia, in reply thereto.]

DR. REYNOLDS' PAPER.

During the year I have had occasion—in such intervals as offered from other and more immediate duties—to give some additional study to the question of the collection and disposal of Chicago's wastes, including ashes and garbage. This study was directed chiefly to the local situation; but the conclusions arrived at have a general applicability which may warrant offering them to the members of the association interested in the subject. The points dealt with are:

First: The desirability of making separate contracts for the collection and disposal of garbage and for the collection and disposal of ashes and other wastes.

Second: The imperfect state of all methods of garbage disposal so far as examined.

Third: The disparity in the values of the utilizable products of reduction processes.

Fourth: The feasibility of simplifying the collection and disposal of certain wastes by a proper control of the junk trade.

1. The desirability of separating the contracts is suggested by the fact that the bidders are generally men skilled in the handling of garbage only, and not familiar with the conditions which obtain with regard to ashes and other wastes.

Any estimate based on the cost of the collection and disposal of ashes in most cities of the country would be too high for Chicago, because of the ready means of disposal with short hauls which this city affords, where clean ashes are in demand and have value for filling purposes. It is probable that most bids are higher than they would be if this fact were fully appreciated, and if the value of the waste paper, rags, metal and other junk collected with ashes were taken into account.

Among other reasons for dividing the contracts may be mentioned the fact that the contractor for the removal of ashes needs no skilled knowledge of garbage collection and disposal. Ashes do not decompose and become a menace to health, as does garbage, if not promptly and properly disposed of.

The penalty for failure in the ashes-removal contract need not, therefore, be so high; and, if divided, either the ashes contractor or the garbage contractor might fail without the one affecting the other. As a matter of fact, the garbage-disposal people do not want anything to do with ashes or other wastes.

Such a division of the work would lessen the labor of the city in enforcing the separation of garbage from ashes by the householder, which separation is a prime condition of economical garbage disposal. And it would, moreover, pave the way for the ultimate assumption of the entire work by the city and the abolition of the contract system, which seems to me desirable.

2. Much progress in the various reduction processes has been made during the last few years, but it may be said that garbage disposal is to some extent still in the experimental stage. Within the next few years it is possible, though not very probable, that Lord Kelvin's process for the "extraction of heat and light from garbage" may be available in this country, as it is asserted it already is in Shoreditch, Eng., or that a still more recent invention may be offered to us—whereby it is claimed that 14,000 feet of illuminating gas are to be obtained from every ton of garbage at a merely nominal cost.

Aside from these possibilities, it is a fact that inventive talent and large sums of money are being directed to the solution of the garbage disposal problem, and that the imperfections which were found in every plant examined bid fair to be remedied in the near future. Even in the most successful plants the operators admitted that improvements and alterations were necessary, and claimed that these were already planned and would soon be made.

Whatever process is adopted, however—whether incineration, reduction, or conversion into fuel or illuminating gas—it still

remains that the handling of garbage in large quantities is attended by certain objectionable features, chiefly the production of offensive and insanitary odors. This precludes the concentration of any considerable amount of garbage, either for shipment or for treatment, in the vicinity of human habitations.

3. The wide disparity in the quantities and in the commercial values of the utilizable products of the various reduction processes in different localities would seem to be an important element in determining bids. These products are chiefly grease and tankage or fertilizer base.

Ordinary city garbage yields from 2.4 to 3.9 per cent., or an average of about 3 per cent. of grease, worth at the present market price 2⅛ cents per pound.

The amount of fertilizer base yielded by the different reduction processes varies from 14 to 15 per cent. to about 30 per cent.—average 22.5 per cent. I have not been able to learn definitely the value of this product; but Mr. MacDonough Craven, one of the New York experts, fixes—as the result of treatment, by different methods, of 3,000 tons of summer garbage from different cities—its average value at $1.27 per ton of garbage. This is probably a minimum figure; it is certainly much lower than anything I heard mentioned in the different cities visited. For the present purpose, however, it may be accepted in order to illustrate the disparity in the values of utilizable products from garbage reduction.

The average daily output of garbage in eight cities where the garbage collected was carefully weighed for several successive months in 1895 was .57 of a pound per capita, or 208 pounds per year of three hundred and sixty-five days. I was able to get accurate figures of the quantity of garbage produced in only three of the cities visited for the purposes of this investigation—namely, Buffalo, Detroit and Bridgeport. In these cities practically all of the garbage output is collected and accurately weighed. They have an aggregate population of 600,000, and their aggregate garbage collection for the previous twelve months averaged 144 tons per day—equivalent to a little less than half a pound per day per capita of population.

It will probably be safe to assume half a pound per day for Chicago, and upon the basis of 1,650,000 population—or 30,000 more than the Department computes the death rate upon—this would give a daily garbage output for Chicago of 412.5 tons per day, or 150,562.5 tons per annum. This would yield the following quantities and values of grease and tankage, according to the processes employed:

Grease:	
At minimum yield, 2.4 per cent.—36,135 tons, at $42.50 per ton	$153,573.75
At maximum yield, 3.9 per cent.—58,719.4 tons, at $42.50 per ton	249,557.45
At average yield, 3.15 per cent.—47,427 tons, at $42.50 per ton	201,565.60
Tankage:	
At average yield of $1.27 per ton of garbage	191,339.65
At minimum yield of $0.847 per ton of garbage	127,526.43
At maximum yield of $1.693 per ton of garbage	255,152.87

These figures show values of utilizable products from Chicago garbage as follows:

By the least productive process	$281.100.18
By the most productive process	504,710.32
By the average of all processes	392,905.25

with a difference of $223,610.14 between the different processes operated in various localities.

These estimates are based on the lowest prices for the products; grease is probably worth a third more, and tankage three times as much as the prices above given.

I was unable to obtain any authentic data of the relative cost of operating the various plants in the cities visited; but it does not seem probable that there can be any such disparity in the cost of operating as there is between the values of the products; and it must be obvious that, all things considered, the method or system which—with due regard to sanitary conditions and inoffensiveness of operation—gets the most out of the garbage must be the best and most economical.

4. The better regulation of the junk trade, which deals with rags, bottles, waste paper, old rubbish, metals, etc., has also a bearing on garbage disposal, inasmuch as these articles frequently find their way into garbage boxes and so add to the labor, which increases the cost of handling.

The trade is quite profitable, and I have reason to believe that if it were properly systematized, its regulation and supervision might be made to yield the city a revenue. Such regulation is demanded also as a sanitary measure, as well as for police purposes. Infected rags, bedding, etc., are frequently stored in junk-shops without proper treatment; while these places are not infrequently used as "fences" for the disposal of stolen property.

The division of the city into junk districts, the letting of the privilege in each to the highest bidder, the location of the shops where they will be least objectionable, are some of the features of this better regulation which have occurred to me. Many minor nuisances might thus be abated and our streets and vacant lots be kept cleaner and more tidy in appearance.

DR. WOODWARD'S ADDRESS.

Mr. President and Gentlemen of the Convention: I will say that Dr. Reynolds' paper is to me like a dream. I think such conditions as he lays down can only exist in the mind of a man and not in actual experience, and I am afraid his statements are not the result of actual experience, but that his paper is rather an ideal study.

In the first place, I fail to realize any advantage whatsoever to be derived from awarding separate contracts for the collection of ashes and for the collection of garbage. I am aware that there is some advantage from a separate collection, but I think it would be decidedly better to award one contract for both, for this reason, that the collector can then work his stock and his plant to the best advantage. There is a very wide variation in the amount of garbage collected during the different seasons of the year. The amount of garbage collected is greatest in the summer, when the amount of ashes to be collected is the least. The amount of ashes to be collected is greatest in the winter, when the amount of garbage to be collected is the least, so that a contractor who has, in order to carry out his contract, been required to put in a plant sufficient to meet the maximum amount of work to be done either in summer or winter, can do the work more cheaply if he can use one equipment for both purposes. That is, he will not have idle carts and horses to carry through the winter, and if he is the contractor for the collection of ashes, he will not have to keep his carts in the stable all summer and pay for the pasturage of his horses. I think the advantage to be derived is rather by letting the contract to one man instead of letting it to two.

As to the question of not requiring skilled labor to collect ashes, and requiring skilled labor to collect garbage, I fail to realize any particular difference. When it comes to the disposal of the two there is a difference, but in the collection as much skill is required on the one hand as on the other.

Whether the work should be done by contract or whether it should be done, as Dr. Reynolds suggests, by the city, is a question which must be settled by each city for itself, and in my judgment it depends entirely upon the freedom of the city government from political control. If the superintendent of that work is enabled to use his own judgment in the appointment and discharge of men, entirely unhampered by political influences, the city could undoubtedly do the work more economically than could a contractor. A contractor with a five or ten year contract, if he is a reasonable business man, must establish a sinking fund on either a five or ten year basis, whereas a city can use any plant which it may equip for the full length of the life of the plant, so that aside from political influence certainly a city should own and operate its own plant.

As to garbage disposal, to which Dr. Reynolds refers, he seemed in most places to use the word disposal as synonymous with reduction. It is not so by any means. Garbage disposal may be either by incineration or by reduction. I do not believe that garbage reduction is any more entitled to be classed as the only method of garbage disposal than is incineration. Dr. Rey-

nolds presented some very pleasing figures as to the value of the Chicago refuse—very pleasing figures, but are they accurate? They may be accurate as to the gross value of the garbage. Garbage may be worth, as has been stated, as much as $2.67 a ton, but what is it going to cost to get that $2.67 out of it? I believe it will cost very nearly as much as that. The fact that Dr. Reynolds, as he states, has been unable to secure any reliable figures as to the cost of operating the plants, is very suggestive. It would be a very unwise policy to work a mine which contained valuable minerals where the amount of the mineral was not equal to the cost of getting it out, and I do not believe it will pay to work garbage that only contains a value which is less than the cost of getting the value into marketable shape.

The amount of grease stated to exist in garbage is probably a little too high, at least that has been the result of my own study. I think, however, that is a matter that will have to be studied in each city. It depends not only on the time of the year, but also on the character of the population. The garbage from a wealthy district where people are reckless as to the use of meats and as to the waste of butter and lard and other more or less costly food products, is much more valuable to the contractor than is the garbage from a poorly settled district. It contains, in the first place, a greater amount of fat, and the fat is the really valuable part of garbage. In the second place it contains a greater percentage of meat, and it is the meat or the animal matter which adds to the value of the tankage. The value of the tankage, which is stated at a dollar a ton, is possibly low. The value of the tankage is regulated solely, of course, by its fertilizer value, and from what I have read and seen of it I think that ordinarily it has a merely nominal fertilizer value. The amount of nitrogen in it and the amount of phosphate is very small. The most valuable part of the garbage is the grease and the tankage, and we have the amount of water and the disposal of the water to be considered, which is a very costly item. After heavy rain or freezing or heavy snow the cost of getting the tankage and the grease out of the garbage and into marketable shape is very considerable, so that I do not believe that it has by any means been demonstrated that any reduction plant can be operated on a paying basis. There is reason to believe that it can be done, but I do not believe there is any satisfactory proof that such is the case.

As to the matter of commercial values, that is a matter for the markets to determine, and the more reduction plants are put up the less will be the commercial value. The tankage is not used as a fertilizer itself, but merely as a filler for other fertilizers, used for the purpose of standardizing them.

The proposition to regulate the junk trade in order to dispose of any of the city waste hardly appears to me to be feasible.

Reference is made by Dr. Reynolds that there is difficulty in requiring the separation of garbage and ashes. If there is difficulty in requiring the separation of garbage and ashes, there would certainly be much greater difficulty in requiring the separation of old rags, old paper, old tin cans and everything else, so that the junk man collects them. There is no real difficulty in requiring the separation of garbage and ashes. It is only a matter of local habit. Here in Washington, where such regulations have been enforced, I think, for twenty-five or thirty-five years, there is no trouble in having ashes and garbage separated. We never have ashes in garbage. The most we are troubled with are tin cans and bottles, and there is no great trouble from those.

I think the whole thing is in the experimental stage. Here we have had, as Captain Beach says, an unfortunate experience. Five or six years ago the city was led into adopting a reduction process. Reduction processes were then much more crude than they are now. The plant was the cause of numerous complaints and indignation meetings and everything of that kind. The Commissioners were annoyed by protests, which they were unable, I think, either to verify or to disprove, and a kind Providence stepped in and the plant was burned down, so that there was no more trouble from the reduction process. The state of the plant then was undoubtedly crude. From an inspection of the remains, which is all I have ever seen of it, I have no doubt that there was some ground for the complaint. The handling of the garbage and the various products was not nearly so carefully regulated as it would be now in any reduction process at present in use, and I have seen most of them.

After that the contractors were allowed to bid for any process they might choose to submit, but the process of cremation was selected. The contractor was required to put up two crematories satisfactory to the Commissioners. One of the crematories selected was what is known as the Brown crematory and similar to one formerly in use in Wilmington, Del. The man who designed that was visionary. It did its work without nuisance, but he designed it to burn at least seventy-five tons every twelve hours. Unfortunately the contract was between himself and the contractor for the collection of garbage, not between himself and the city, and there was nothing said as to whether the twelve hours should be consecutive hours or not. Nothing was said as to whether the garbage contractor should be entitled to deliver garbage during those twelve hours. As a matter of fact, in a practical test the best that crematory could do was seventy-five tons in twenty-four hours, but it could burn seventy-five tons in twenty-four hours without nuisance.

The second crematory was of the Smith pattern. That is similar to the one that was in use in Atlantic City and similar to two that were in use in Philadelphia. But the engineer in charge of of that undertook to improve it. The trouble with this other crematory has been the leakage from the bottom of the cell. The garbage was not burned on grates, but was burned in an immense cylindrical cell and naturally the water in the garbage leaked out of the doors at the bottom of the cell, which were placed there for the purpose of drawing the ash. Whether the failure of that crematory was due to the improvements or not I am unable to state, but it was certainly a failure and had to be closed. The result was then that the city was left with a crematory which could burn the winter garbage, but could not burn the summer garbage, and rather than undertake to divide the disposition in that way it was thought best to give the contractor permission to remove his garbage down the river on scows, as he had formerly done, and there dispose of it on a farm belonging to himself by ploughing it under the land. That contract is at present being carried out. This farm, however, was not accessible by railroad, and in order to meet the difficulty which might arise by the freezing of the river, the contractor was required to keep the Brown crematory in such condition as to be ready for use. So that the present system of disposing of the garbage in the District of Columbia is by means of scowing down the river and putting it on the land so long as the river is open, and at such periods as the river is frozen, and whenever, for any other reason, it may become impossible to take the garbage down the river in boats, it must be burned in the Brown crematory. That system is working satisfactorily to us and satisfactorily to the contractor, who, I believe, makes considerably more money out of it than he would out of the burning.

The method of collecting the garbage here is by storing it in the yards. Householders are not allowed to set garbage on the public streets nor in the alleys. They are required by law to provide a water-tight, metallic receptacle, with a tight cover, and those receptacles are not allowed to be smaller than of ten gallons' capacity or larger than thirty gallons. The contractor is required to distribute cards announcing to the householders the days on which he will collect garbage—that is, during the seasons when he collects only twice a week or three times a week. The garbage is hauled in a cart that is probably familiar to some of you, known as the Flannagan cart, a semi-cylindrical steel body revolving on an elevated axle, so that it is easily dumped, and which is free from angles and therefore readily kept clean.

The service rendered is a daily service from April 15 to November 1 in the city itself, and during that same summer period it is a tri-weekly service in the county, in the more densely populated suburbs of the city. In the winter season, from November 1 to April 15, there is a semi-weekly collection over the

entire city and more densely populated suburbs. The contractor is required to collect and dispose of garbage. He is also required to collect and dispose of dead animals, and for the whole service the city pays $57,000 per annum. The contractor is subject to fine for failure on his part to collect garbage or dead animals, and if the failure is a gross one—that is, if in the case of dead animals he fails to collect after ten hours' notice, the city has the privilege of collecting such animal and charging the cost to the contractor to the extent of $10. Similarly if he fails to collect any specified garbage after twelve hours' notice the city can cause it to be collected and charge him whatever it may cost up to $10. So that any single failure on his part may result in a loss of as much as $15 to him, by way of fine and the cost of collecting. The imposition of such fine and cost of collection under the provisions specified is left discretionary with the Health Officer. As a result of that we have a very good collection service.

I have here some figures which may be of interest to you. I think Dr. Reynolds hardly got as far as Washington in his journey. For the fiscal year ending June 30, 1898, the total amount of garbage collected was 23,167 tons, giving an average per day of 63.47 tons or an average per thousand inhabitants per annum of 82.66 tons. The amount collected at each collection is left out of this statement, but of course it is somewhat greater than the amount collected daily, because there are not as many collections as there are days in the year, for while, as I have stated, there is a daily collection between April 15 and November 1, between November 1 and April 15, during the winter season, there is only a semi-weekly collection.

During the same year there were collected 10,121 dead animals, including the smaller and the larger dead animals, an average of 27.75 per day.

The entire number of complaints received during the whole year was only 571, an average of 1.56 per day. And of those complaints I will say that certainly not more than 50 per cent., and possibly not more than 40 per cent., were justly chargeable to the contractor, because householders are very apt to complain that their garbage is not collected, without stopping to inquire whether it is the fault of their servants or the fault of the contractor. In certainly 50 per cent. of the cases we find that the fault is due to neglect on the part of the householder or his servant.

From the amount paid we deduct certain fines, and then we pay the weigher, the man who has charge of the scales and who counts the loads at the wharves, so that the amount deducted during the year for which I have given the figures was $782. Practically the amount received by the contractor was $56,000. For a daily service in this District the average number of vehicles in use was 56. The maximum is about 65. For a semi-weekly service the number required was about 30. The number of horses required in summer averaged 62 and in winter 36. The number of men employed in summer was 56 and in winter 30. This shows from our own local conditions the correctness of the point I have made that the contractor who has to collect both ashes and garbage could do so more easily than one who has to collect but one thing. The garbage contractor must have at least 50 carts, but in the winter an average of 26 of those carts are idle. He must have certainly 62 horses, but in the winter he needs only 36. The number of men employed is 56 in summer, but as the winter season comes on he must discharge 26 of them. The discharging of those men and the employing of green help in summer is, of course, always a source of trouble in the early part of the season.

As the result of my own observations, I think the best system of garbage collection and disposal I have seen has been that in Detroit. With Dr. Reynolds I think that any system of disposing of garbage must be located at a distance from the thickly populated parts of a community. Here we are embarrassed somewhat for transportation. The bidders on the last contract said they were unable to make any terms with the railroad companies for the transportation of such materials at all, but in Detroit the garbage was collected in a steel cart body, which was taken to the station, where it was removed from the running gear and put directly on the body of a flat car. The carts, as they came in, were lifted clear of the wagon body and a clean cart body put on the wheels. In the early hours of the morning, or the late hours of the night, the car is attached to a freight train and carried out a distance of sixteen or twenty miles from town and there disposed of, in that instance, by reduction. The system of disposing of garbage that far away from town is of very small sanitary importance. From the financial aspect it pays, because the sanitary and economical aspects of garbage reduction are certainly opposed, and a nuisance which in a city could only be prevented by expensive devices can at that distance from the city be ignored. That is, if it is more economical to cool your tankage in the open air, you can do it. If it is more economical to run your foul water onto a piece of land and dispose of it by irrigation or filtration,or however you wish,you can do it. You have not got to do as you have to do in the vicinity of a large population, which is to dispose of the water by evaporation.

The system of collection and garbage disposal to which reference is made whereby power is secured from the garbage is a little different from what we have in Washington. The word garbage as there used includes not only what we include in the term garbage—that is, pure swill from the kitchens and market-house refuse—but also includes waste paper, waste from stores, and, I think, ashes. That is all put in an ordinary furnace and burned and the waste heat utilized. Here we dispose of our kitchen swill and market-house refuse independently of all other forms of refuse. I may as well say that the city does not even collect refuse of any other sort, does not collect the ashes, does not collect the general refuse. If you can collect all of your waste I think certainly you would do as well to collect the garbage and general refuse together and collect the ashes separately. The ashes, of course, tend to check any fire into which they may be introduced, unless they are screened. On the other hand, general refuse, such as waste paper sweepings from stores and factories, tends to absorb the moisture from the garbage and adds valuable fuel to the material if it is to be burned. So I think it will be well when we finally establish both services to collect our ashes separately from the other refuse. The ashes, of course, can be readily disposed of, but the other refuse cannot. It may be possible, then, to generate heat and utilize it from the waste, but under the present system I think it is entirely impracticable.

The crematory in use in Montreal, like the crematories in use on the other side of the water, burns all sorts of refuse. There in that northern city, where they collect everything together, and where they have, of course, very long winters and very great quantities of ashes, they collect their garbage and refuse of all sorts and dump it directly into a furnace, and there it is burned. No fuel is added at all, and they find they get along without it. Of course there is waste heat there, and the foreman told me they had a boiler in the stack and operated it successfully when they needed, but that they had taken it out because they found that when they wanted to clean the boiler they had to shut down. There were considerable quantities of smoke coming from the stack, and the stack fire was seldom used.

On the whole, then, I think you will finally come to the conclusion that the most practical method of collection is to collect the garbage and general refuse at one time and ashes at another. The ashes may be screened, and the fuel and cinder used possibly to help burn the garbage and refuse, but the garbage and refuse will, I believe, best be burned separately. The ideal system of collection and disposal will probably be the collecting in a cart body and transporting by rail outside of the city; and until the chemist and the engineer have improved present methods, I do not believe anybody will make a fortune out of garbage reduction.

COATING OF CAST IRON AND STEEL PIPES.

[EDITOR'S NOTE.—This is the first publication of the report of the special committee on coating of pipes to the convention of the American Society of Municipal Improvements.]

When we consider the large amount of cast iron and steel pipe that has been laid and is still being laid in the cities and towns

of the United States for the purpose of furnishing water to the inhabitants of said cities and towns, the immense amount of money invested in the conduits, buried as they are under the ground, out of sight, and not accessible for regular inspection, we are at once confronted with the great importance of making these pipes as durable as possible by protection from the rust, and taking every precaution to prevent their capacities being reduced either by chemical action or the adhesion of foreign substances. The cost of the coating is so small in comparison with the total cost of the pipe laid in the ground, and the beneficial effect of the coating is so great, both as increasing the durability and efficiency of the pipe, that the greatest care should be taken in selecting the best material and applying it under careful inspection, watching carefully every detail of the work, particularly in the case of wrought iron and steel pipes, where experience has shown that deterioration is very rapid without a coating, and that the longevity of the pipe depends almost entirely on the kind of coating used and the skill with which it is applied.

The subject of pipe coating was so thoroughly taken up by the committee having that subject in charge last year that your present committee find it very difficult to get any definite information that will be of any particular interest to the association. It was the opinion of the committee at that time, and is also the opinion of the present committee, after considerable correspondence on the subject, that entirely too little attention is paid to the coating of cast iron pipes. We think, however, as a result of last year's work, the matter has been more particularly called to the attention of engineers and superintendents, and that where contracts for pipe have required proper inspection in this particular, better work has been done. A casual examination of a large amount of pipe for the city of Chicago showed some very excellent results, and some correspondence with the principal inspecting bureaus for this class of work also shows that they realize the importance of careful attention to the material used and the proper application. By the courtesy of one of these bureaus the committee has received analyses of some of the materials used, but I must confess that to an uninitiated mind the results do not contain much information and do not form an intelligent basis for any special requirements in specifications. We think that if the suggestions of last year relative to the quality and application of the coal tar products are carried out, the results will be satisfactory.

In regard to steel pipe, your committee has corresponded with nearly all the places where steel pipe has been laid that were mentioned in the report, but have been able to obtain very little information as to the results of a year's test on various pipes laid at that time.

Mr. E. Kuichling, of Rochester, N. Y., to whom we were indebted last year for much valuable information, writes as follows: "As to further experience with pipe coating, I have little further to add, except that a quite recent examination of the interior of our new conduit at a locality where 36-inch cast iron and 38-inch steel pipe coated with Sabin's japan could be conveniently compared, showed that the coal tar pitch coating of the cast iron pipe exhibited numerous tubercules of relatively large size, while the steel pipe was practically as clear from corrosion as when first laid. Both of these pipes were laid and put into service in October, 1894, and have been used continuously up to the date of said examination, about ten days ago. The two kinds of pipe are parts of the same line. A striking peculiarity was the development of extensive organic growths on the interior of the cast iron pipe, while little matter of this kind was found in the steel pipe. It should, however, be noted that the cast iron pipe began at the storage reservoir, and had a length of about 1,000 feet before the steel pipe was reached; it is therefore possible that the organic growths mentioned might have attached themselves equally well to the steel pipe coating if the latter had been nearest to the source of supply, and thus had first opportunity to obtain the necessary air and food conveyed by the water."

Mr. D. C. Clarke, assistant engineer and superintendent of the Portland, Ore., works, in reply to inquiries as to how the pipe coating was standing in that city, writes as follows: "The asphalt coating we have used has shown signs of failure in places, but the cause of such failure has not been satisfactorily determined as yet. I enclose herewith a sample of the coating, about one inch square, which was taken from the inside of one of our mains about six months ago. The material seems to be tough and of good quality, but for some reason it failed to adhere to the steel in places as it should have done, possibly through failure to maintain the bath at the proper temperature or to heat the metal thoroughly before removal from the bath. I know nothing in the way of an asphalt bath than that which would be obtained by a strict compliance with the letter of the specification sent you in September, 1897."

We learn through Mr. Sabin, an able authority, who is giving a good deal of attention to the proper coating of pipe used in large war vessels to convey water over the ships for fire and other purposes, that experiments with the Sabin process have been very successful and that a plant for coating the pipes with the Sabin method had been erected in the Brooklyn Navy Yard by the Boston Electroduct Company.

In other instances where pipe had been laid no special examination seems to have been made, and it seems to have been the opinion of those in charge of the various works that as long as nothing had happened of such a nature as to call for investigation, it was well to let good enough alone, so we can draw the general conclusion that thus far the different pipes have been satisfactory.

It would appear to your committee that in the coating of steel pipes the question as to what coating is the best is still unsolved, and that no general rule can be given, but what may prove the best under certain local conditions may not prove as efficient under other conditions. Changes in temperature may necessitate some changes in the compound, but above all it would appear that the pipe should be thoroughly cleaned before any application is put on, and it is only by careful and intelligent consideration of all these little details that the best results can be obtained. In these days of close competition, where there is a tendency to cut the edges as closely as possible, it is particularly necessary to inspect with the greatest care to secure the best results.

It has been unfortunate that the committee on pipe coating has been so widely separated that we have not been able to have any discussion on the subject. It was my intention that we should meet in Washington and form a report there, but almost at the last moment I find I shall be unable to attend the convention.

I send this brief report to bring the subject before the convention, hoping that other members of the committee may be better prepared, and the members of the association who have had such work in hand may present something as to the results of their experience that may be of interest and profit.

Respectfully submitted,
L. W. RUNDLETT,
Chairman.

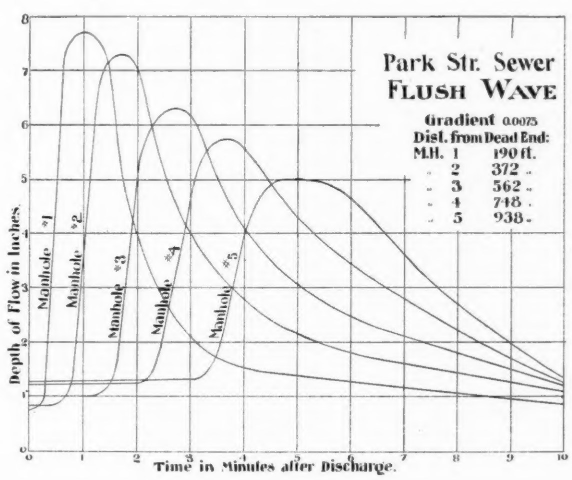
OBSERVATIONS OF THE EFFECT OF FLUSHING DEVICES FOR SMALL SEWERS.

[EDITOR'S NOTE.—This is the first publication, in full, of a paper by Asa E. Phillips, of the Engineer Department of the District of Columbia, read before the recent convention of the American Society of Municipal Improvements.]

The general principle of the flushing device is to suddenly discharge into the sewer a considerable volume of water for the purpose of cleansing the pipe of stranded solids. As a rule, the siphon is six inches or eight inches in diameter, and is usually somewhat smaller than the sewer to which it is connected. The quantity of water is measured by the horizontal section of the tank, as the depth of discharge is ordinarily constant for one size of siphon. The amount of discharge per second varies somewhat for the different varieties of the device, and different local conditions, but is roughly stated as one cubic foot per second for the 6-inch siphon and two cubic feet for the 8-inch. No formula has been proposed for the volume of water required for different grades and sizes of sewer, and the only rule known

to have been used appears to be of little value. This important detail is usually determined by individual judgment, often unsupported by investigation or experiment, so that the common practice has varied within a large range of values, and the capacity of the tank most often has been made uniform, regardless of the size or gradient of the sewer to which the siphon is connected. The uncertainty as to the precise effect of the flush and the complex conditions as to contributing population, rate of water consumption, etc., has been justly considered a bar to any precision in this regard. Recent discussion of the subject, however, has tended to establish certain limitations in the use of flushing devices, which should lead to improvement in the general practice.

The work to be accomplished by the flush is the removal at regular and frequent intervals of solid matter flushed into the sewer from house laterals, and there stranded, because of the shallow depth of flow and sluggish current, carrying the same down the line to a point where the depth and velocity are sufficient to insure removal to the ultimate point of discharge. The efficiency of the flushing device in performing this work is not well understood. But little is known of the effect of the flush under the constantly varying conditions encountered, especially for widely different grades, and at considerable distances from the dead end. It is generally considered, however, that the

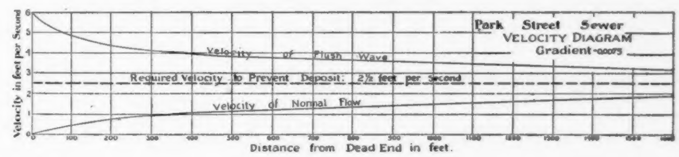


effect diminishes very rapidly as the distance increases, and becomes almost imperceptible 600 or 700 feet from the tank. But so far as can be ascertained, this has been observed only in cases of flush of small volume, on flat grades or where the depth of ordinary flow was considerable. Of the effect of discharges of 600 gallons or more, such as were used in the cases to follow, there appear to be no recorded observations, so that no comparison with those already published can be made. Several grade conditions have been selected for the purpose of illustrating the effect of the flush under such circumstances, and an attempt has been made, by means of diagrams, to indicate the different results obtained.

The Park street line is the first of these. This sewer is twelve inches in diameter, about 1,870 feet in length, and has a uniform grade throughout of nine inches per 100 feet. Preliminary examination discovered slightly unfavorable conditions for experimental work, such as a somewhat uneven grade and rough joints in places, all of which affected observations and results to some extent. It may now be stated that, with the exception of the Chapin street line, the sewers cited are old, and generally possess these irregularities; but, except slight silt accumulation at points distant from the basin, they were found to be very clean. The presence of silt in the invert, particularly at manholes, undoubtedly affected the flow, and was the chief source of error in the observations.

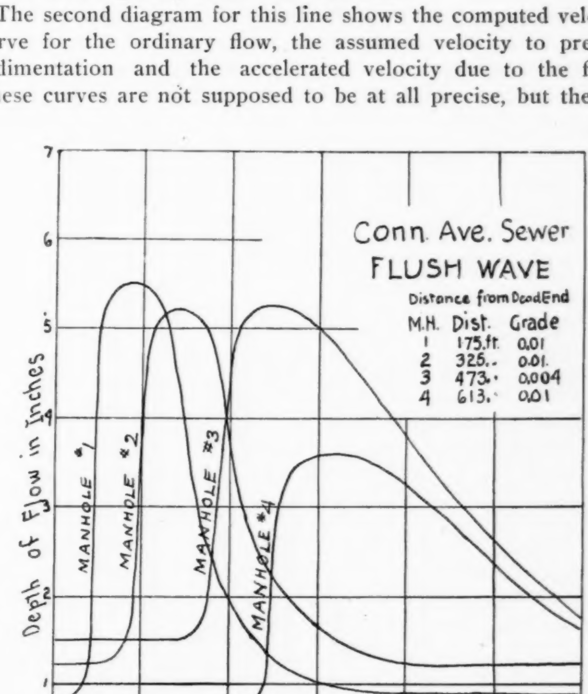
The tank on Park street was found to have an effective capacity of 84 cubic feet, or about 630 gallons, and discharged through an 8-inch siphon in the mean time of 42 seconds. No attempt was made to determine the velocity at the point of discharge, but this data would indicate an approximate mean velocity of six feet per second. Observations of the flush were simultaneously taken at all the manholes, and the depths of flow were recorded at intervals of fifteen seconds or less. These observations were referred to the time of siphon discharge, and the diagrams have been constructed from this datum.

The first diagram shows the form of the flush wave as taken at five consecutive manholes within 1,000 feet of the tank. The lower five manholes were not plotted, because of the confusion of lines that would result; but the data are given in tabular form.



This diagram and tabulation show how well the depth of flow is maintained for very long distances. At 1,000 feet from the dead end the flush is very efficient, and at a distance of nearly 2,000 feet appears to be quite effective. This large radius of effect is doubtless due to the volume of water used, as published data for smaller discharges indicate that a tank of one-half this capacity would have a greatly diminished influence.

The second diagram for this line shows the computed velocity curve for the ordinary flow, the assumed velocity to prevent sedimentation and the accelerated velocity due to the flush. These curves are not supposed to be at all precise, but they il-



lustrate the purpose of the flushing device, and, to some extent, the degree of effectiveness required. The curve of normal flow

Table I.—Park Street Sewer.

Capacity of tank = 84 cubic feet = 630 gallons. Time of discharge = 42 seconds.

Reach.	Size.	Grade.	Distance. Feet.	Mean Normal Depth. Inches.	Max. Depth of Flush. Inches.	Duration of Greatest Effect.
Tank to M. H. No. 1..	12" d	0.75%	200	0.75	7.75	1 m 00 s
" " " 2..	12" d	0.75%	382	0.87	7.25	1 m 15 s
" " " 3..	12" d	0.75%	572	1.00	6.25	1 m 45 s
" " " 4	12" d	0.75%	738	1.25	5.75	2 m 00 s
" " " 5..	12" d	0.75%	942	1.25	5.00	2 m 15 s
" " " 6..	12" d	0.75%	1,132		No observations.	
" " " 7..	12" d	0.75%	1,332	1.38	4.50	2 m 50 s
" " " 8..	12" d	0.75%	1,486	1.50	4.00	3 m 00 s
" " " 9..	12" d	0.75%	1 688	1.75	3.50	3 m 45 s
" " " 10..	12" d	0.75%	1,869	1.75	3.25	3 m 45 s

shows the very low velocity along the upper portion of the line, and its gradual increase approaching the required velocity near the lower end; while the flush curve shows a corresponding high

velocity at the upper end, and its rate of fall toward the 2½ feet per second velocity, where, in theory, at least, it would seem the two curves meet at a common tangent point. In this case it may be noted the normal flow does not attain a rate of 2½ feet per second, and probably would not within a distance of 2,000 feet. It is also to be observed, however, that the flush maintains this velocity for a distance probably as great. So that so far as these observations go, they indicate that for this very long line and flat grade the flush tank is efficient and of the proper size.

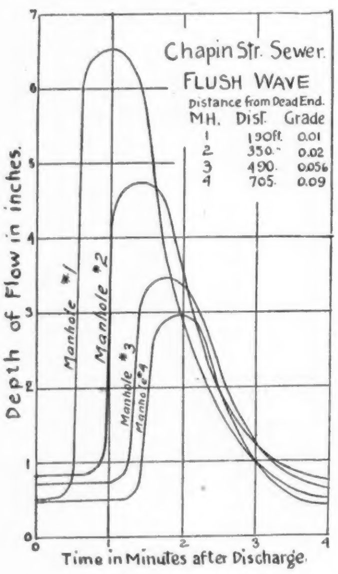
The second series, taken on one of the Connecticut avenue sewers, is only of interest as showing the effect produced on a varying and decreasing gradient. The diagram illustrates the diminished velocity and enlarged area of section recorded at manhole No. 3, which, unfortunately, could not be further observed, owing to a change in grade from this point. It perhaps indicates, however, that for a line of varying grade the minimum slope should be considered in fixing the capacity of the tank.

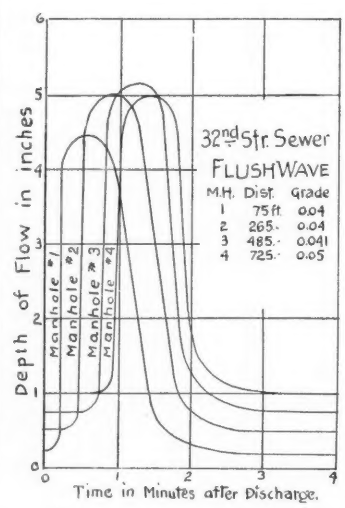
TABLE II.—CONNECTICUT AVENUE SEWER.

Capacity of tank = 82 cubic feet = 615 gallons. Time of discharge = 45 seconds.

Reach.	Size.	Grade.	Distance. Feet.	Mean Normal Depth. Inches.	Max. Depth of Flush. Inches.	Duration of Greatest Effect.
Tank to M. H. No. 1..	12" d	1%	175	0.87	5.50	1 m 15 s
" " " 2..	12" d	1%	325	1 25	5.25	1 m 30 s
" " " 3..	12" d	0.4%	473	1 50	5.50	3 m 00 s
" " " 4..	12" d	1%	613	1.00	3.50	3 m 00 s

The third series was taken on the Chapin street sewer, which has the reversed condition of a varying but rapidly increasing





gradient. The observed effect of the flush is very clearly shown by the diagram. The rapid run-off and greatly reduced area of

TABLE III.—CHAPIN STREET SEWER.

Capacity of tank = 83 cubic feet = 620 gallons. Time of discharge = 48 seconds.

Reach.	Size	Grade.	Distance. Feet.	Mean Normal Depth. Inches.	Max Depth of Flush Inches.	Duration of Greatest Effect.
Tank to M. H. No. 1..	12" d	1%	190	0.50	6.50	1 m 15 s
" " " 2.	12" d	2%	350	0.75	4.75	1 m 00 s
" " " 3 .	12" d	5.6%	490	0.75	3.50	1 m 00 s
" " " 4..	12" d	9%	705	0.50	3.00	1 m 00 s

section toward the lower end indicate the high velocities which such steep slopes must produce. In this case the minimum grade being one per cent., and that for a length of but 190 feet, a flush tank of considerably smaller capacity would probably be equally effective.

The fourth series, taken on one of the Thirty-second street sewers, shows the observed effect on a nearly uniform steep grade. The first diagram gives the form of the flush wave as observed at each manhole. The quick run-off and nearly uniform depth maintained indicate the piston-line effect of the discharge. The flow was so rapid and so quickly passed as to render the taking of the observations difficult and their entire accuracy somewhat doubtful. The curves seem to indicate such unavoidable irregularities, but the general effect is very clearly shown.

The second diagram indicates the approximate velocity attained by the flush in connection with the assumed 2½ feet per

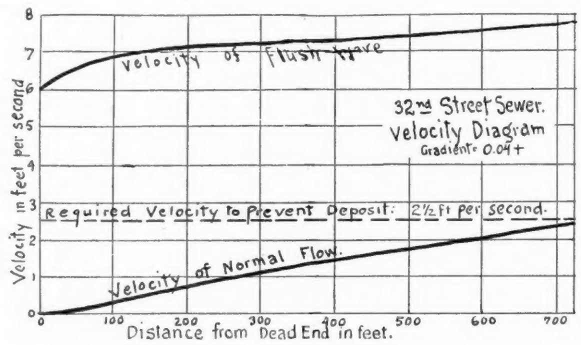
TABLE IV.—THIRTY-SECOND STREET SEWER.

Capacity of Tank = 84 cubic feet = 630 gallons. Time of discharge = 45 seconds.

Reach.	Size.	Grade.	Distance. Feet.	Mean Normal Depth. Inches.	Max. Depth of Flush Inches.	Duration of Greatest Effect.
Tank to M. H. No. 1..	12" d	4%	75	0.12	4.50	1 m
" " " 2..	12" d	4%	265	0.25	5.00	1 m
" " " 3..	12" d	4.1%	485	0.75	5.12	1 m
" " " 4..	12" d	5%	725	1.00	5.00	1 m

second constant, as well as the velocity of ordinary flow. This shows in another form the marked effect of the discharge on a steep slope, and also how quickly, on such a grade, the normal flow attains sufficient velocity to prevent deposit, all of which would seem to indicate a lack of necessity for automatic flushing on such gradients.

As has been stated, no formula has yet been proposed for the quantity of water required to flush for the several conditions as to size, gradient, etc. In a general way it has been said "long lines on flat grades require greater capacity of tanks than steep grades or short lines," but no effort to formulate these factors for discussion has been made. Aside from the cost of construction and maintenance, economy in the use of water would give to this subject some importance, for one 400-gallon tank requires for a 36-hour discharge no less than 100,000 gallons per annum. The uncertain and variable conditions controlling the amount of ordinary flow, etc., would make such a formula of little practical usefulness; however, it would seem of some value in considering the factors in the problem, which are compara-



tively well understood, at least so as to show to some degree the limitations governing the use of this device for the conditions which are easily determined. Briefly, the object of the flush is to procure a periodic velocity of more than 2½ feet per second in the upper portion of the sewer, and to maintain the same to a point where the ordinary flow attains this rate. Disregarding the amount of ordinary flow in the sewer, it is evident that the quantity of water to satisfy this condition is a function of the diameter of the sewer and its gradient. From general consideration of the well-known formula for velocity, $V = c\sqrt{RS}$, remembering that for circular conduits the hydraulic radius is a direct function of the semi-diameter, we may consider (1) the quantity, Q, varied directly as the square root of the radius and inversely as the square root of the slope; and to complete the statement of controlling conditions, (2) that it varies directly as the length of sewer from the dead end to the point where the normal flow becomes sufficient to maintain a velocity of 2½ feet per second. Under these assumed conditions, designating this distance by L, letting C represent the necessary modifying coefficient, the formula would take the shape,

$$Q = \frac{L\sqrt{R}}{C\sqrt{S}}.$$

Solving this equation for the data given on the Park street line, we obtain a rough approximation for C of 190.

Let us now consider the factors which establish the value of L. If we let A represent the area of cross-section of normal flow for any given gradient required to produce the velocity of 2½ feet per second, and let D equal the increment in normal

flow for each linear foot of sewer, in cubic feet per second, then

$$L = \frac{2\frac{1}{2} A}{D}$$

in which A is definitely determined by an application of Kutter's formula. The quantity, D, is evidently a function of the number of persons or premises tributary to the sewer, and of their per diem water consumption. But these are variable quantities, rarely the same for two sewers. A uniform contributing population of thirty persons per 100 feet of sewer, with a daily flow per capita of 100 gallons, three-fourths assumed to run off in six hours, would give a value for D of 0.00015 cubic feet per second.

The following table gives the value of A for different grades and sizes, and the corresponding depth of the flow in inches:

TABLE V.

Grade.	Areas of Section for 2½′ per Sec. Velocity in Square Feet.				Depth of Flow for 2½′ per Sec. Velocity in Inches.			
	6″ d	8″ d	10″ d	12″ d	6″ d	8″ d	10″ d	12″ d
½%	....	0.230	0.227	0.237	...	5.0	4.3	4.1
¾%	0.135	0.131	0.138	0.150	3.9	3.2	3.0	2.9
1 %	0.096	0.102	0.108	0.115	2.9	2.7	2.5	2.4
2 %	0.043	0.050	0.055	0.060	1.7	1.6	1.6	1.5
3 %	0.031	0.036	0.038	0.041	1.3	1.3	1.2	1.2
4 %	0.023	0.025	0.028	0.031	1.0	1.0	1.0	1.0
5 %	0.018	0.021	0.025	0.028	0.9	0.9	0.9	0.9

This table indicates the very small flow on the larger grades necessary to maintain a self-cleansing velocity, and the relation between the ordinary discharge and the grade within the limits given. The following table gives some of the quantities of water obtained by the formula for the foregoing grades and sizes, using the value of D previously given as a mean, and allowing an increase rate on long lines and a diminishing rate of flow on short lines:

TABLE VI.

Grade.	12″ d	10″ d	8″ d
½%	100	90	80
¾%	80	65	55
1 %	70	55	45
2 %	35	30	20
3 %	25	20	15
4 %	20	15	10
5 %	15	10	8

From these tables we may conclude that a very considerable modification of the volume of water should be allowed for lines of different gradient, and that the required volume diminishes quite rapidly with an increase of grade; also that the volume is affected, but to a less extent, by changes in the size of the sewer. That for all sizes no flush tanks are probably required on slopes exceeding 2 per cent.; and, it may be inferred, in such cases flushing at less frequent intervals than 24 to 48 hours is necessary.

The rule previously alluded to is given by the Van Vranken Flush Tank Company, and is as follows: "The capacity of the basin should be equal to that of one-half the length of sewer in which the grade produces a rise equal to the diameter of the pipe." For purposes of comparison with the formula already given we may readily reduce this statement to the form

$$Q = \frac{\pi R^3}{S},$$

in which

Q = quantity of water required, in cubic feet.
R = radius of the sewer, in feet.
S = slope.
π = constant = 3.1416.

In this formula it is seen Q varies as the third power of the radius. That this does not appear to satisfy the hydraulic conditions imposed may be readily seen; for example, in the case of a 10-inch and a 12-inch pipe, the quantities for which should not greatly differ. Only about one-half the quantity is given for one as for the other. And again, Q varies directly as the slope, giving but one-half the quantity for an 8 per cent. as for a 4 per cent. grade. The effect of changes in gradient or size is thus exaggerated, as inspection of the formula at once indicates.

To a less degree the proper proportioning of the flush tank would seem of the same importance as that of the sewer itself. But in communities having a limited supply of water, the question becomes more serious, and in one case, at least, has seemed to justify abandoning the use of automatic flushing altogether. This single experiment, however, can hardly be said to justify such practice. The hand flushing resorted to is reported to have kept the system in working order, but the actual condition of the sewers would have to be more carefully studied before concluding this method an unqualified success. Certainly the flush tank is an excellent device, and under the best conditions performs its work admirably. That its automatic operation is considered by many to be very unreliable is almost entirely due to a lack of understanding of simple physical laws, as well as to the deep-rooted impression that this is a sort of perpetual motion machine, once started, to run forever. With reasonable care in construction and maintenance, the siphon will give a service perhaps equalled by no other mechanical device, and will perform the work of flushing with almost absolute regularity.

The allowance of an insufficient volume of water, in designing the tank, is a frequent error, and has probably brought the flush tank into some disfavor; for a small discharge is found to exhaust its effect within a short distance of the dead end, without accomplishing the work intended, while at the same time the annual expenditure of water has been more than sufficient for a thorough if less frequent flushing by other means. No arbitrary minimum for the capacity of the basis can be stated, but it seems probable that for sewers requiring less than 300 gallons mechanical flushing had best be omitted. And finally it would appear that the flushing device can hardly be expected to impart a cleansing velocity on grades too small to maintain the same.

In conclusion, it may be stated that the formula here suggested is not expected to exactly satisfy the fixed hydraulic conditions of the problem. That it approaches the form which such an equation should have, and indicates the limits governing the use of flushing devices, is all that can be said.

A STUDY OF PAVING MATERIALS.*

BY GEORGE W. TILLSON, MEM. AM. SOC. C. E.

The discussion of paving materials is nearly as old as pavements themselves. In the early times, availability generally determined the kind to be used, but as our cities increased in size and importance the question as to what was the best received and is now receiving a great deal of attention. It is not easily settled, because the best material for one section is not necessarily the best for another. However intelligently the question be considered, it will never be possible to arrive at a conclusion that will suit all cases. A perfect pavement, however, possesses certain qualities, and by a careful study of these it will be possible to assign them a value which will be permanent in all locations. By next taking up the different materials offered for paving purposes and examining them with reference to these already assigned values, a result can be reached that will give a fair average value of any material. These results can be tabulated, and by knowing all the conditions affecting any street, a proper selection can be made by applying the table.

A perfect pavement should be cheap, durable, easily cleaned, present little resistance to traffic, not slippery, cheaply maintained, favorable to travel and sanitary.

The question of first cost is very important. As with individuals, so it is with corporations, what is most economical in the end must often be given up and an inferior article adopted, because the available funds will not permit the required outlay. If the best cannot be used, the one nearest to it must be taken, provided it comes within the appropriation. An advocate of a new paving material is almost invariably met with the question, What will it cost? If the price be extreme, he will have a hard task to introduce it, no matter how great his other attractions may be. Cheapness, then, has been given a value of 15 out of a total of 100.

Durability is probably the most important quality of any material. Ultimate cost depends as much upon this as upon first cost. No matter how cheaply a pavement may be laid, or how

*Paper read at Washington Convention of the American Society of Municipal Improvements, October, 1898.

pleasing it may be, if it require constant and frequent renewal its real value is greatly diminished. This is especially true in large cities, as the delay and inconvenience to business on a crowded street may often amount to more to abutting tenants in dollars and cents than the actual cost of the pavement. In a country, too, like America, where the tendency is to build and then allow repairs to take care of themselves, durability is most important. Its value has been fixed at 21.

The growing demand for clean streets in our cities has brought into prominence any pavement that can be easily cleaned. What this amounts to in money can be appreciated by a statement made in December, 1896, by Colonel George E. Waring, Jr., at that time Street Cleaning Commissioner of New York City. At a meeting of the American Society of Civil Engineers, he said that if all the streets of New York were paved with asphalt where the grades would permit and the street car tracks constructed with grooved rails, the cost of sweeping the entire city would be reduced from $1,200,000 per annum to $700.000. That is, there would be a saving annually of $500,000, which capitalized at 4 per cent. would amount to $12,500,000 in a city that at that time had a pavement mileage of 431 miles, of which 94 were already paved with asphalt. Easily cleaned is assigned 15.

Resistance to traffic is an important item. In fact, one of the chief provinces of a pavement is to reduce this, and consequently a pavement that can bring this to a minimum is of particular value. A mechanical device that would reduce the friction of a machine fifty, or even twenty-five, per cent., would be of incalculable benefit, yet a good pavement on a street accomplishes this. It makes one horse do the work formerly performed by two. Its assigned value is 15.

The slipperiness of a pavement depends primarily upon its material, but a great deal upon its condition. The former will be considered here. The efficiency of a draft horse must vary with his foothold. If it be good, he will be able to use his entire strength to draw his load, while if he be in constant danger of slipping and falling, he can accomplish very little. Very few statistics have been gathered on this point. One case can be given, however, when observations of traffic were being taken on several streets in the winter time. On the first day the hourly traffic was at the rate of 225 tons between 11 and 12 o'clock, reaching 270 tons between 3 and 4 o'clock. On the day following the traffic between 11 and 12 o'clock was 305 tons. About 2 o'clock snow began to fall, making the pavement very slippery, reducing the travel to such an extent that it had fallen off to 40 tons between 3 and 4 o'clock. That is, it was comparatively deserted. All of the other streets upon which observations were being taken showed the same results. Not slippery has been valued at 7.

Maintenance is closely allied to first cost. Unless it be known and considered in the adoption of a material, a choice cannot be made intelligently. What seems to be sound selection will often be ruled out by the cost of repairs. Any material will require constant attention, but that one which needs the least and permits that to be done with the least inconvenience to the public is of most value. Cheaply maintained has been given a rank of 10.

By favorable to travel is meant the ease and comfort that is enjoyed in driving over a smooth pavement, and the decrease in the wear and tear of vehicles and horses. No attempt ever has been made to measure this in actual money, but it is known to be great. It is a pleasure to drive over some pavements and actual pain to drive upon others. As our streets are for enjoyment as well as use this property must be considered. The large number of bicyclists constantly on our highways makes this especially important. Its value is placed at 5.

Another function of a pavement is to preserve health. In large cities it is impossible to prevent decaying matter from being deposited in our streets. If a pavement be of such a character that any of this collect in joints so that it is not removed by the street cleaners, it cannot but be very deleterious to the general health. Consequently, a pavement that is impervious to water, has a smooth surface, and is not itself composed of organic matter, will be sanitary. Noise, too, must be considered. A noisy pavement prevents sleep, rasps on the nerves of the sick, and prevents conversation on the street. This question of noise is of such importance that in Greater New York estimates have recently been made for repaving around all schoolhouses in the city with a smooth and comparatively noiseless material. Sanitation is ranked at 13.

Having thus briefly outlined the characteristics of a pavement and assigned them a value, it will now be in order to take up these characteristics with reference to the different materials, and apportion to each its amount according as it approaches perfection in each property.

The pavements to be considered are granite blocks laid on 6 inches of concrete with tar and gravel joints, called Granite A; granite blocks laid on sand with joints filled with the same, called Granite B; asphalt wearing surface two inches thick, binder one inch, on six inches of concrete; brick also on a concrete foundation six inches thick with joints filled with pitch or cement; Belgian trap blocks on sand; Macadam eight inches thick, and cobblestone. Wood has not been taken because it is only being used now in some of our western cities, and as laid can only be considered as a substitute for a pavement. It may be said that this is practically true of cobblestone. That may be so, but its use illustrates the scope of the table. This table, according to its present values, is available only in the vicinity of New York City. But the theory of it is correct, and modifications can be made so that it will apply to any section desired.

First cost varies, of course, in each locality, and each material will vary in its percentage as the price varies. Taking the average of the bids received in Brooklyn in 1897, we have:

Granite A	$2.50
Granite B	1.65
Asphalt	1.75
Brick	2.00
Belgian	1.40
Macadam	0.75
Cobblestone	15

all per square yard complete.

Assuming their value to be inversely as their cost, we get Granite A 2, Granite B 4, Asphalt 4, Brick 3, Belgian 5, Macadam 7, and Cobble 14.

It is somewhat difficult to assume any definite period as the life of a pavement. In some cases the amount of traffic determines it entirely. But when a pavement is laid of perishable material like asphalt or wood, while wear will hasten the end, it has a period of life beyond which it cannot go. Assuming the traffic, then, to be normal, the time the different materials should last with ordinary repairs is:

Granite A	25 years
Granite B	20 years
Asphalt	15 years
Belgian	20 years
Brick	15 years
Macadam	8 years
Cobblestone	18 years

Figuring as before, we have for their percentages:

Granite A	21
Granite B	17
Asphalt	13
Brick*	13
Belgian	17
Macadam	7
Cobblestone	15

Some figures already have been given as to the value of having a pavement that is easily cleaned. The street that uniformly presents a smooth and even surface can be cleaned at much less expense than one that is rough and uneven. Working on this principle, Granite A gets 11, Granite B 8, Asphalt 15, Brick 12, Belgian 7, Macadam 5, and Cobble 2.

Many experiments have been made to determine the amount of force necessary to draw a load over different roadways. The results vary greatly, as the attendant conditions are so many that tests cannot be expected to agree, except as to general results.

According to the best authorities, the number of pounds required to move a load of one ton at a speed of three miles per hour, the grade being level, is:

Granite A	36
Granite B	45
Asphalt	17
Belgian	38
Macadam	42
Cobblestone	75

Brick must be between Asphalt and Granite A.

This, then, will give a percentage to Granite A of 7, Granite B 5, Asphalt 15, Brick 11, Belgian 5, Macadam 5, and Cobble 3.

The relative slipperiness of the different materials often has been discussed. It varies greatly with its condition. For instance, asphalt is more slippery when it is dirty and wet, granite when it is clean and dry. Extended observations were taken in London by William Haywood, Engineer of the Commissioner of Sewers, in 1873, to determine the number of accidents occurring on different pavements. From his results, he deduced that a horse would travel 132 miles on granite, 191 miles on asphalt, and 330 miles on wood without having an accident of any kind. In 1885, Captain, now General, F. V. Greene had a series of observations made in ten of the principal cities of this country for the same purpose. From these, he decided that in the United States a horse would travel on wood 272 miles, on granite 413 miles, and on asphalt 583 miles without an accident. In both of these cases the falls were divided into those upon the knees, the haunches, and complete falls. Falls upon the knees on a rough pavement should not wholly be charged to slipperiness, as a great many must have been caused by stumbling. Captain Greene found that of a total of 84 falls, 68 were upon the knees. Assuming that one-half of the latter were stumbles only, the deduction would be that a horse would travel 698 miles on granite without an accident due to slipperiness. These results, of course, are general. From these and other observations, Granite A is given 6, Granite B 5, Asphalt 3, Brick 6, Belgian 4, Macadam 7, and Cobble 5.

The cost of maintenance of pavements varies greatly in different cities. It is governed principally by the character of the material, amount of traffic, and the condition in which the streets are kept. What is good repair in one city would not be allowed in another. The records on this subject are very meagre. Systems vary in all places, and not much attention is paid to the cost of any particular street. Granite well laid requires very little repairing. Asphalt has generally been repaired by contract after the expiration of a five years' guarantee. Some cities pay a price per yard for the entire street; some pay for the actual quantity of new pavement, and others for the amount of material used. Under ordinary traffic, the repairs should not cost more than six cents per yard per annum. Brick has not been in use long enough to obtain reliable information upon its cost of maintenance. In this paper it has been assumed to be the same as asphalt. Belgian block requires but little repairing, as it is hard and well resists the action of travel. The cost of maintaining macadam is great and variable. The reports of the City of Glasgow, Scotland, show that the total cost of macadam repairs for the years ending May 31st, 1896 and 1897, was ten cents per yard, and in London they sometimes reach sixty cents per yard, and in Paris forty-four cents. In Nashville, Tenn., the stone used is so soft that the streets often require re-surfacing several times a year. Traffic tells very quickly on this kind of a pavement. The values allowed are Granite A 10, Granite B 7, Asphalt 6, Brick 6, Belgian 7, Macadam 3, Cobble 2.

Probably no figures can be found upon which to base a calculation for favorable to travel. Yet, the saving to livery men, firms and corporations employing many teams must be great when poor pavements are replaced with good. Stone pavements are very severe upon both horses and vehicles, especially when they are a little out of repair. The allowances are made arbitrarily. Under this head Granite A has 3, Granite B 2, Asphalt 5, Brick 4, Belgian 2, Macadam 5, Cobble 0.

There is a great difference in the sanitary value of the materials in question. Asphalt can be kept absolutely clean; it is impervious to water, free from noise, and has all the requirements of a sanitary pavement. Granite A and Brick have their joints well filled with permanent material and have an even surface. Granite B and Belgian have joints loosely filled with sand, which is soon swept out more or less and replaced with street refuse of all kinds. Decaying as it does, it is offensive and detrimental. A cobblestone pavement never can be kept clean. To make it so would remove all the earth that maintains the stones in place. All stone pavements are very noisy, and so are illy fitted for streets near hospitals, schoolhouses, churches or similar buildings. There is no doubt but that the noise from stone pavements contributes largely toward all nervous disorders. Macadam is extremely dusty, absorbs moisture of all kinds, and is hardly to be considered for a city street, though it ranks high in some respects. In the old City of New York the number of deaths from all causes in 1892 was 44,329; 1893, 44,486; 1894, 41,175; 1895, 43,420; 1896, 41,622; and in 1897, 38,877; showing an absolute decrease in that period of 5,452, despite a large increase in population. This is a remarkable record. It is accounted for by increased sanitary measures in general, and largely to the laying of asphalt pavements on the east side, where the population is larger per acre than in any city in the world. The streets have been kept clean, and they are, in a measure, the recreation grounds of the people. As a sanitary pavement, then, Granite A receives 9, Granite B 7, Asphalt 13, Brick 10, Belgian 5, Macadam 5, and Cobble 2.

The table can now be completed. By summing up the values under each head, the true worth of each material is obtained, and by comparing these totals with each other, we arrive at their relative rank:

	Percentage.	Granite A.	Granite B.	Asphalt.	Brick.	Belgian.	Macadam.	Cobblestone.
Cheap	14	2	4	4	3	5	7	14
Durable	21	21	17	13	13	17	7	15
Easily cleaned	15	11	8	15	12	7	5	2
Light resistance to traffic	15	7	5	15	11	5	5	3
Not slippery	7	6	5	3	6	4	7	5
Cheaply maintained	10	10	7	6	6	7	3	2
Favorable to travel	5	3	2	5	4	2	5	..
Sanitary	13	9	7	13	10	5	5	2
Totals	100	69	55	74	65	52	44	43

Having constructed the table, it will now be in order to illustrate its use: Assume, for instance, a street over which the traffic must be great and continuous, ultimate cost is of great importance. It overrules first cost. Light resistance to traffic and also foothold for horses, ruling elements, so that any power may draw the maximum load. The items first to be studied, then, are: Durability, maintenance, traction, and the not-slippery property. Consulting the table and combining the values for these items, Granite A has 44, Granite B 34, Asphalt 37, Brick 36, Belgian 33, Macadam 22, and Cobble 25. Granite A has such a decided lead over the others that it would hardly be necessary to make a further examination before coming to a decision, but when the figures are as close as the next four, ranging from 37 to 33, a careful study of the remaining qualities would be required. In this particular instance Granite A stands so near the top on the totals and so far ahead in the special requisites, it would seem that no mistake could be made in selecting it as the material to be used.

Consider next a residential street built up with homes, whose owners have means sufficient to afford the best of anything they desire, and while not wishing to be extravagant, they do want and expect to have the best pavement that can be laid without regard to expense.

This is a different proposition. First cost, durability, and maintenance, of the utmost importance before, can be left out entirely. Easily cleaned, not slippery, favorable to travel, and

sanitary are the governing characteristics. Now, Granite A has 29, Granite B 22, Asphalt 36, Brick 32, Belgian 18, Macadam 22, and Cobble 9. Asphalt possessing all the desired properties in so high a degree should be selected without question. It may be said that durability and maintenance are too hastily disposed of, and that by considering them the results would be changed. But here is the point of the whole argument: The property owners can afford the best. They would not carpet their drawing-rooms with hemp matting, because it would last longer than tapestry, nor furnish their dining-room table with crockery and pewter, rather than with china and silver. The idea is the best material under required conditions. The above conclusions would generally hold good for the best retail business streets.

Now let us take a residence street with very light traffic, where the abuttors wish a good but an economical pavement, one that will be durable and as near first-class as their pocket-books will admit. This requires careful consideration. The destructive action of travel is almost eliminated; durability will be governed by the action of the elements. Every quality but light resistance to traffic must be taken into account. This gives Granite A 62, Granite B 50, Asphalt 59, Brick 54, Belgian 47, Macadam 39, and Cobble 40. Granite A leads, but it gets its supremacy from its great durability under traffic, a property that A 41, Granite B 33, Asphalt 46, Brick 41, Belgian 30, Macadam is not required here.. Leaving this out, there remain Granite 32, and Cobble 25. All but the three leading materials can now be eliminated, leaving for further consideration Granite A, Asphalt, and Brick. Now, while durability has been left out, its value has been determined by the action of traffic and weather. In this case, action of traffic is left out, and when it is considered that asphalt has a life that is determined by climatic conditions, irrespective of condition of traffic, it will be seen that in such a case as this Granite A and Brick can consistently be placed above it. These two materials now stand at the same value, 41, but by examining the table it will be seen that Granite A gains four points over Brick on maintenance, simply on account of its superiority under heavy travel. Leaving that out of our total, Granite A has 31 and Brick 35; and this is plainly the proper material for the street.

If the property owners, however, think the price too high, and prefer granite with its inconveniences to the more pleasing brick, then Granite B would be the choice. But it must be understood that money casts the deciding vote.

Assume next that a country highway is to be improved where the traffic is not heavy, but the road is needed to facilitate the intercourse between towns, or to connect a suburban village with the parent city, Sanitation, Easily Cleaned, Durability (except as to action of weather) and Light Resistance to Traffic can be eliminated—Sanitation and Easily Cleaned, because on a sparsely settled road matters are unimportant that could not be allowed in a city; the other qualities because no heavy loads will be attempted. There will remain, then, Granite A 21, Granite B 18, Asphalt 18, Brick 19, Belgian 18, Macadam 22, Cobble 21. Here the values are more nearly alike, but the cost of the first five materials will rule them out, when there can be no question between macadam and cobble on account of the undesirability of the latter, even though the former has but one point in its favor. By modifying the foundation for brick under these conditions, it would very likely make a good showing, and in many localities prove the proper material.

The above illustrates the workings of the table, and while there are many imperfections in it, as much of it has been settled arbitrarily by the author, and allowance must be made for the personal equation, it does seem, to him, at least, that it is a step in the right direction; that it is getting away from glittering generalities, establishing plain figures for certain elements that have not been valued in exact terms before, so that they can be understood and of service to those wishing information. If this attempt brings forth discussion here at the present time or later in other circles sufficient to place these figures at their true value, the author will feel fully repaid for the labor expended upon this attempt.

RAILWAY TRACKS ON PAVED STREETS.

[EDITOR'S NOTE.—Following is the report, in full, of the Committee on Street Paving of the American Society of Municipal Improvements, submitted to the recent Washington Convention.]

To the President and Members of the American Society of Municipal Improvements:

Gentlemen: Your Committee on Street Paving has not had the success in securing papers for presentation to the convention which it had hoped and expected. The Committee appreciated the fact that the subject of laying and maintaining pavements had been thoroughly discussed on previous occasions, and as it was not directed by the last convention to submit a report upon any particular subject, it was considered wise to try and present some new phases of the paving problem.

In the early part of the last summer a circular letter was addressed to members of the Society in all of the cities represented, asking for papers upon the following subjects:

"First. The selection of paving material:—That is, what material is best suited for certain conditions, taking into consideration first cost, economy of maintenance, ease of traction, durability, sanitation, etc. This problem will, naturally, have different solutions in different localities, and under varying kinds of traffic; but a careful consideration of the special qualities of different paving materials should result in conclusions which will be of value and interest to the Society.

"Second. Railroad track construction in paved streets:—The character of foundation, form of rail, and kind of pavement best adapted for use in connection with tracks having in view permanency of structure, with least possible disturbance of the surface for repairs, and a minimum of obstruction to the use of the street by vehicles.

"Third. The obligations of street railroads and other corporations as to maintenance of pavements between their tracks or over their sub-surface construction. Would not more satisfactory results be obtained if railroad companies were to pay a fixed sum per mile of track per annum to the city, and the latter assume all responsibility for repairs and renewals?

"Fourth. Regulations to restrict and control the opening of pavements by corporations, plumbers and others."

It was explained that the Committee did not wish to obtain descriptions of methods followed in various cities, unless these methods had special merit to recommend them; but was anxious to secure information which could not be obtained elsewhere, and which would be of real value to the members of the Society. While a number of responses were received to this circular, they nearly all stated that it would be impossible for the writers to prepare papers.

The Committee felt that there was no subject at the present time of more vital interest to municipal officers than the effect of street railway tracks upon pavements, and it has ventured to make this the subject of special investigation and report.

The relations between street railway corporations and municipal officers is too often hostile rather than friendly. In many of the older cities such corporations have been given franchises which impose few, if any, obligations upon them as to the care of the pavements between their tracks. These franchises have usually been given in perpetuity, and the companies often seem to regard as an impertinence any criticism of the method of track construction, or of the condition of the pavement on the portion of the street occupied by them, while the suggestion that the company contribute even a portion of the expense of substituting a new pavement is so preposterous as to be ludicrous. Yet there is no problem requiring more patient consideration, or which should be taken up with a spirit of greater fairness than this one of street railway track construction, the best kind of pavement to be laid along and between the rails, and its proper maintenance.

An insolent disregard of the rights of the public on the part of some few railway corporations is doing more to bring about partial or complete municipalization of railroads than anything else. The question of compensation for franchises, the quality of service given the public, etc., are not subjects which properly concern your Committee on Street Paving; but the method of track construction, the section of rail used, and the kind of pavement laid along and between the rails are proper and most important subjects for its consideration.

Early in August a circular letter was addressed to the officers of twenty-eight of the most important street railroad companies in the United States. This letter requested answers to the following questions:

"What is your standard rail section? Is it a side-bearing, grooved or tee rail, and is the form prescribed by the municipal officers? Is there any reasonable objection to the use of a grooved rail, and are you permitted to use a tee rail in any paved street?

"Does your company lay and maintain the pavement between the tracks?

"On asphalt streets is the pavement carried up to the rail on either or both sides, and, if so, do you find it difficult to maintain such pavement?

"Do you favor the use of a tee rail in paved streets, and do you think that stone and asphalt pavement can be maintained along such rail?"

Your Committee wished to ascertain the views of the officers of important companies, known to be well managed, and to see whether or not they were disposed to attach proper importance to this question of paving in connection with their tracks. The information asked for has been received from seventeen of the companies, and the general character of their answers will be seen from the accompanying tabular statement. The spirit of

Table showing rail sections favored by street railway officials and their opinions as to kind of paving most successful along tracks

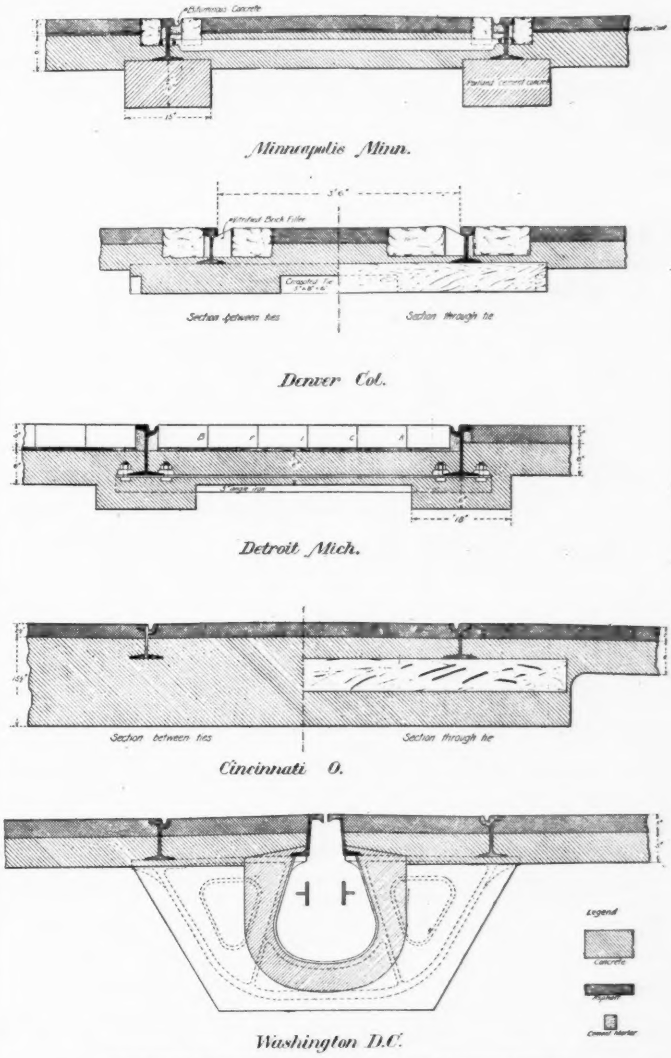
Railroad Company	Rail in General Use: Section	Height	Weight	Paving along rails on Asphalted Streets	Can asphalt be successfully maintained along rails	Objections to Grooved Rails	Is Tee Rail favored in paved streets if permitted
Albany Railway	Side bearing girder	9"	90 lb	Formerly granite toothing Asphalt now carried up to rails	Yes	Snow & ice in this latitude fill groove	Yes
Binghampton R. R. Co.	Grooved	9"	——	Asphalt against rails for last two years	Yes	None	No Experience
Brooklyn Heights R. R. Co.	Side bearing Girder and Grooved	9"	94 to 98½ lb	Asphalt along rails & stone toothing	On outside but not on inside of rails	Not from dirt, but it is more difficult to maintain pavement than with side bearing rail	Yes if permitted by City officers
Buffalo Railway Co.	Semi-grooved	9"	94 lb	Stone toothing	No	Snow, ice & dirt would cause great trouble with full grooved rail	Would probably be successful, but not permitted
Cincinnati St. Ry. Co.	Grooved On Cross ties set in Concrete	6" & 9"		Asphalt along rails both sides	Yes	None	Not better than grooved rail now in use
Denver Consolidated Tramway Co.	Tee with creosoted cross ties on concrete foundation	6"	72 lb	Stone toothing	No	No Experience Tee much preferred	Yes Under local conditions, gauge 3½ ft and street wide
Detroit Citizens St Ry Co	Grooved laid in concrete no cross ties	——	38-29	Asphalt outside Brick between rails	Yes on outside not on inside	None	No Not better than section used and difficult to maintain pavement
Lincoln Traction Co	Tee	6"	62 lb	Vitrified brick in all cases	No Asphalt in City	No Experience	Yes
Market St Railway Co San Francisco Cal	Side bearing Girder and Tee	Not given		Stone Toothing	No	Dirt makes rough riding - Nothing to recommend it	Yes, with good Tough stone along rails
Metropolitan Traction Co New York	Grooved Girder with Extended Tram	9"	107 lb	Asphalt along rails and stone toothing	Yes but repairs are frequently required	None, with extended tram to carry wheels of vehicles	Not permitted nor favored
Nassau R. R. Co. Brooklyn	Side bearing Girder	9"	90 lb	Asphalt along rails & stone toothing	Only with difficulty	Impossible to keep track clean except with asphalt pavement	Yes
Washington D.C.	Grooved			Asphalt along rails both sides	Yes	None	
New Orleans Traction Co.	Side bearing Girder	[illegible]	90-100	Stone toothing	No	Dirt in grooves requires more power & makes rough riding	Yes on streets wide enough to accommodate vehicle outside of tracks
Union R. R. Co. Providence R. I.	Grooved adopted by R. R. Committee	9"	98½ lb	Asphalt against rails	with difficulty	No objections stated	Not favored nor permitted Neither stone nor asphalt can be maintained along them
Toronto Railway Co.	¾ Grooved	6½	73 lb	Stone toothing. Asphalt against rail in some cases	No	None	Neither stone nor asphalt can be maintained along them
Twin City Rapid Transit Co Minneapolis & St Paul	Tee laid on concrete no cross-ties	7"	80 lb	Asphalt tried but abandoned for stone toothing	No	Many objections but not stated	Yes
Union Traction Co. Philadelphia	Side-bearing Girder	9"		Stone blocks both sides of rail	No	Decided objections on account of difficulty in keeping clean	No, except with very light traffic and brick pavement
West End Ry Co. Boston Mass	Side bearing Girder some Grooved	9"	90 lb	Stone toothing. Asphalt against rails in some cases	Only with great difficulty	Object to use reasons not given. Obliged to use in some cases	Favored except for difficulty in maintaining any pavement

fairness manifest by most of the replies is gratifying, and indicates that the companies, as well as municipal officers, are devoting much attention to the problem of paving that part of the street used by them. The fact is becoming appreciated that, as stated by the general manager of the New Orleans Traction Company:

"In the construction of tracks in paved streets the pavement forms a large proportion of the expense, amounting in many instances to as much or more than the track construction proper, and as the stability of each depends largely upon that of the other, only the best material and methods in track and paving construction should be used, and that each should be laid without respect to expense, in the best possible manner, which will surely be the cheapest in the end."

The railroad companies must understand that the privilege of operating their cars in city streets is a very valuable one, and that when they occupy the central half or third of the roadway (as is usually the case in the narrow streets of Eastern cities), they must expect to maintain the best class of modern pavement in thoroughly good condition. They cannot expect to treat a public highway, purchased and improved by the people, as they would a private right-of-way on which they have exclusive rights. The municipality must also understand that upon good transit facilities depend in a large measure the expansion and development of the city, and that a corporation which is disposed to give good accommodations and quick transit is a public benefactor, and should be given every encouragement and facility for improving its service.

Repairs to track in paved streets are necessarily expensive, and every effort is now being made to build as substantially as possible. The laying of heavy rails upon a foundation of concrete, dispensing altogether with wooden cross-ties, is no longer



SECTIONS SHOWING RECENT TRACK CONSTRUCTION.

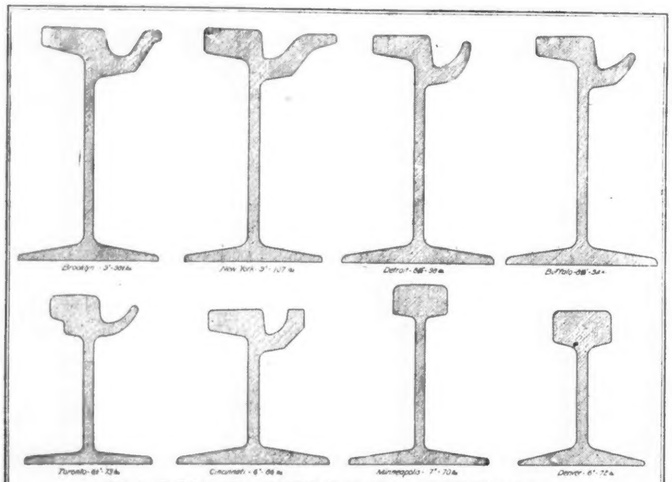
an experiment, having been especially successful in Detroit, Denver, Minneapolis, St. Paul, and Toronto. The methods of construction in Cincinnati, Denver, Detroit, Minneapolis and Washington are shown in the accompanying sketches. As to the form of rail, there is considerable variation, and difference of opinion, though that most in favor among railway companies is the 9-inch side-bearing girder, weighing 90 pounds or more to the yard, though in several places where permitted by the law or the municipal authorities the tee rail seems to be in favor, while municipal officers generally prefer a grooved rail. Considerable opposition has been manifested by the railway companies to the grooved rail, but when its use has been insisted upon they have soon accepted the situation, and find that there is no difficulty connected with its use. One railway official writes:

"We do not use any grooved rails for the reason that they are very poorly adapted to the street-car business. * * * In fact, I know of no reason for the use of grooved rails anywhere, except that it is a fad of certain theorists who have no practical knowledge of the business, which, like other fads of the kind, such for instance as the narrow gauge for railways, must have its little day of popularity among the ignorant and inexperienced, to be finally cast aside as soon as the public have had experience enough with it to know what it really is."

The tee rail would be deservedly popular were it not for the difficulty of maintaining pavement of any kind alongside of it, though in Minneapolis, St. Paul, and Denver it is claimed that this can be successfully done. The question of pavement alongside of the rails (especially inside) in asphalted streets is difficult of solution. One of our replies says:

"It has been my experience in connection with railroads in different cities that asphalt and street railroad tracks are hereditary enemies, and that brick or stone between the rails and the tracks and for a foot outside is a much better kind of pavement than asphalt."

Your Committee is disposed to agree with the sentiment that asphalt and street railroad tracks are hereditary enemies, but is convinced that with substantial track construction, and the proper kind of rail, an asphalt pavement can be maintained on both sides of the rail where the traffic is light, and that with the use of a toothing course along the inside of the rail where the traffic is heavy asphalt can be used on railroad streets as well as any other material.



SOME TYPICAL RAIL SECTIONS IN USE IN DIFFERENT CITIES

After a careful consideration of the facts and opinions elicited by the letters received in response to their inquiries, and such personal investigations as have been made, your Committee would report the following conclusions:

Only the most substantial and permanent track construction should be permitted in important paved streets. The tracks should be laid upon a concrete foundation, metal cross-ties being substituted for wood, resulting not only in greater permanency, but saving depth of concrete.

The best form of rail is the grooved girder, nine inches in depth where streets are paved with stone, and seven inches deep where paved with asphalt. In some cases where streets are very narrow, and vehicles are obliged to follow the tracks, the nine-inch side-bearing girder may be preferably selected, stone blocks of granite or trap being laid along the inside of each rail, and at the same level as the head of the rail. On exceptionally wide streets, where the traffic is not heavy, and will occasionally cross the tracks obliquely, but not follow them, tee rails may safely be used.

The pavement along the rails will depend upon that used on the remainder of the street. If the latter is of stone blocks, the pavement along and between rails should be the same, but in all cases should be of selected blocks upon a substantial concrete foundation, the joints filled with fine gravel and paving pitch. If of brick the same practice should be followed, the joints along and between rails being filled with similar paving pitch in whatever way the joints on the remainder of the street may be treated.

On asphalted streets the asphalt may safely be carried up to the back of the rail, and if full-grooved rails are used, and the vehicular traffic is light, it may be carried entirely across the roadway. For heavy traffic the spaces between the rails and tracks should be paved with selected granite, or other hard, tough blocks laid on concrete with pitch and gravel joints. For moderate traffic a toothing course of carefully selected blocks, four inches wide and varying in length about three inches, but in no case more than ten inches long, should be laid along the inner side of the rails, whether grooved or side-bearing. These blocks may be laid in pairs of two long and two short, in which case the asphalt along them can be tamped more thoroughly.

In all cases blocks next to the rail should be bedded in rich cement mortar, rather than laid upon a sand cushion. The spaces under the head of the rail should be filled with fine cement concrete, leaving a vertical joint between this filler and the pavement, whether the latter be stone, brick or asphalt.

Openings made for repairs to track should be immediately restored before the stone blocks become injured, or the adjacent pavement or foundation disturbed. Such openings being shallow, this can always be done without danger of settlement.

Respectfully submitted,

N. P. LEWIS, Brooklyn, Chairman.
EDWARD B. GUTHRIE, Buffalo.
GEORGE M. AMES, Grand Rapids.

PURIFICATION OF SEWAGE.

BY E. G. BARROW, CITY ENGINEER, HAMILTON, CANADA.

There are few questions of more interest than that of the best manner of disposing of the sewage of our towns and cities, and it may be also said few questions are beset with greater difficulties. When it is considered that this subject has occupied the minds of some of the most practical analysts, engineers and scientists of Europe for many years back, and even at the present day there still exists a great diversity of opinion as to the best method to be adopted, it may well be pronounced a question difficult of solution. It would seem wisdom to avoid becoming a partisan of any particular system, because it frequently happens that the surroundings of a city, the nature of the soil in its vicinity, value of land, etc., dictate the best methods to be adopted in each particular case.

The methods of purification best known at the present times are: 1st. Broad irrigation, or the distribution of sewage over large tracts of land, having in view the growth of useful crops, called sewage farming. This system will take 4,000 to 6,000 gallons per acre per day. 2nd. Land filtration, in which purification is obtained by the passage of the sewage through light soil with little or no attempt to grow crops; 60,000 gallons may be used to the acre on this plan. 3rd. Chemical precipitation, in which the purification is obtained by means of certain precipitants, such as lime, alum, salts of manganese, sulphate of iron, which precipitate all the suspended matter in tanks, and also remove a small part of organic matter in solution.

Combinations of the above are frequently made. To these methods have been lately added the septic tank system adopted at Exeter, England; the biological method, by which the purification is sought to be obtained by means of bacteria contained in filters, generally made of coal, coke, polarite, etc., the treatment lately advocated by Mr. Adeney, of Dublin, Ireland, in which after precipitation with salts of manganese the effluent is treated with nitrate of soda to complete purification.

Ordinary city sewage is a mixture of a very complex character, and is derived from the discharge taking place from water closets, sinks, and also manufacturing wastes,

and in those cities having the combined system of sewerage, various substances from the streets. The quality of sewage in different cities varies considerably, the difference being largely caused by the nature of the manufacturing wastes which are received into the sewers. A gallon of ordinary sewage contains about 100 grains of solid matter, 30 grains being in suspension and 70 in solution, 60 grains of which are mineral and 40 organic matter, the analysis of which would yield to each 100,000 parts the following results:

Total Solids.	Suspended.	Alum.	Free Ammonia.	Organic Ammonia.
140	40	20	5	1

What is required to be done is the removal of all matter in suspension and as much as possible of the organic matter in solution. The organic ammonia or albuminoid ammonia is generally considered by chemists to be the most reliable index of the amount of polluting matter present in the sewage. The removal of the suspended matter is at present best done by means of chemical precipitation, but the effluent so obtained still contains organic matter in solution, which unless discharged into a large body of pure water is liable to set up secondary decomposition. The removal of the organic matter in solution contained in the tank effluent may be almost completely done by filters composed of either coal, coke, polarite, land, etc.

The advocates of the biological method of purification say that the matter in suspension may be liquefied by liquefying bacteria, which are cultivated and sustained by the air and sewage contained in the filter, and by this means the sludge would be entirely done away with. But grave doubts are expressed by sewage experts as to the ability of these bacteria or micro-organisms to perform this office, or in plain language they do not believe that they can "get away" with the sludge, and the opinion is generally held that with average town sewage there will be the sewage sludge accompaniment. A writer on this subject facetiously remarked that if the bacteria can be utilized to eat up the sludge, what a pity it is they cannot be trained to drink up all the liquid.

TANKS.

Precipitation tanks are made both circular and rectangular—their capacity being based on the maximum daily flow of sewage. If the quiescent system is adopted the tanks should be so arranged as to permit the liquid sewage to have at least a rest of one and a half hours. If the continuous flow system be adopted, then sufficient capacity must be allowed so that two hours at least will elapse during the passage of the sewage through the tanks. Provision has also to be made for the tank when not in use, and for the first part of storms. Experience has demonstrated that they should be of medium size, as very large ones have been found more difficult to manage. The parts in contact with the liquid sewage must be smooth, and the sludge drains should have quick slopes toward the sludge well. Experience has shown that no danger from freezing may be apprehended in this latitude in winter time. The precipitants most commonly used are lime, alum, soluble salts of manganese, sulphate of iron.

FILTERS.

A well-designed and well-operated filter, all agree, is a most excellent and efficient purifier of sewage. Formerly it was believed that its action was merely mechanical, or that of a fine strainer. Subsequently it was found that those polluting organic matters in solution contained in the sewage which had an affinity for oxygen underwent chemical decomposition and were transformed into new products of an innocuous nature, and this result was brought about by minute living organisms called nitrifying bacteria, so that in fact the purification was chiefly due to these bacteria. A filter should be so constructed that air can permeate its whole structure. It must also have periods of rest. The most modern way is to allow the clarified tank effluent to completely fill the filter so that the liquid just appears over the top of the filter; after remaining there for about an hour it is discharged by opening a valve situated at the bottom of the filter. Very good results have been obtained, however, by allowing the sewage to be distributed over the surface of the filter by means of gutters, and allowing the liquid to filter slowly through. The filters should be several in number and each allowed a period of rest. The very best results have been obtained from filters composed of coal, the depth being about 4 feet, and the sizes varying from half inch cubes to one-sixteenth inch cubes. It is said that coal produces a better effluent than any other substance experimented with, having a chemical as well as bacteriological action. I have been making experiments with coal filters and also with mixtures of coal and slag, and with sand and coke, and certainly the effluent from the coal filter is the best. It is necessary that all suspended matter be removed before the effluent reaches the filter. Sewage disposal has been more studied and has made more advancement in England, Germany and France than in any other parts of the world, but this has probably been caused, especially in England, by dense populations situated on the banks of comparatively small bodies of water (this does not apply to those cities situated on the seaside); whereas in America, with the huge fresh water lakes and gigantic rivers into which the sewage is discharged, evil effects are not felt for many years, and it is only when the cities reach a large size that sewage purification becomes necessary and imperative. Now, both in the United States and Canada, cities and towns are beginning to feel the necessity of disposing of their sewage. Much may be learned by experience gained in Europe, still I am of opinion that climatic differences and other purely local conditions will lead the American and Canadian mind, so prolific in invention, to perhaps improve on the European methods of purification, or at any rate to evolve some plans that will be particularly adapted to the needs of our climate and country.

The following practical deductions from the consideration of this subject suggest themselves: The sewage farm should only be selected when land situated near the city is suitable in character, and below or very little above the sewer outlets, and of reasonable price. If such land is not available and a high rate of purification is required, clarification in tanks by chemicals, followed by filtration, is the best plan. Collect by means of intersecting sewers all sewage to one station, so that all can be under one management. If part of the sewage needs pumping and part could be carried to purification station by gravity without pumping, then two stations might be the most economical. Such would be our case in Hamilton. In building a filter select the very best material, which I would say, without hesitation, is coal. It will give a better effluent and necessitate a less area than any other material.

The researches and experiments made by Mr. Adeney, of the Royal Dublin Society, on polluted waters, are of great value to the subject of sewage purification. He examined the gases contained in polluted water and the changes which took place in these gases, due to fermentation. These changes were caused by living organisms, and he discovered that it was necessary to supply them with oxygen in order to promote healthy bacteriolysis. This oxygen he supplied by adding pure water (which always contains a certain amount of dissolved oxygen) to the polluted sewage water, and if sufficient was added purification was completed, but if not, putrefaction fermentation would take place. His examination revealed two distinct stages of bacterial fermentation; the first he called carbon oxidation, and the second nitrification of

(Continued on Page 198.)

CITY GOVERNMENT.

Devoted to all Departments of Municipal Work.

PUBLISHED MONTHLY BY

CITY GOVERNMENT PUBLISHING COMPANY,
108 FULTON STREET, NEW YORK.

BUSINESS DEPARTMENT:
CLARENCE E. STUMP. B. F. GILKISON.
EDITORIAL DEPARTMENT:
H. J. GONDEN, Editor. F. D. POTTER, Associate.

TERMS OF SUBSCRIPTION.
In the United States and Canada.............................per annum, $3.00
In all Foreign Countries.. " 4 00

Subscriptions payable in advance, by check, P. O. money order or express money order, to order of CITY GOVERNMENT PUBLISHING CO.

RATES FOR ADVERTISING SPACE QUOTED ON APPLICATION.

SPECIAL NOTICE.

City officials and friends of City Government visiting New York are cordially invited to make the office of City Government their headquarters during their stay in the city. Desks, stenographers and stationery are placed at their disposal, and their mail may be addressed in our care.

NOTE AND COMMENT.

The First and Best Municipal Journal.

The last municipal convention of the year was that of the American Society of Municipal Improvements, held at Washington, the last week in October, and the first full report of the important papers and addresses delivered on the occasion appears in this number of CITY GOVERNMENT. This journal has every reason to be proud of its convention record for the year 1898, for there has not been a national gathering of city officials of which it has not furnished the first and best report. When the American Water Works Association met at Buffalo in June, an issue of CITY GOVERNMENT containing all the important papers of the convention was delivered in that city before the meeting adjourned. The most important municipal convention of the year—that of the League of American Municipalities at Detroit—was reported promptly and fully in CITY GOVERNMENT, involving the publication in full of a large number of the most interesting and valuable addresses on municipal topics ever prepared in this or any other country. CITY GOVERNMENT scored a complete "scoop" on the important proceedings of the convention of the International Association of Fire and Police Telegraph Superintendents, held at Elmira, in August. Next came the annual meeting of the International Association of Fire Engineers, at St. Louis, and again CITY GOVERNMENT gave to the world the first and only complete report of the proceedings. With this issue we close the convention season by "scooping" all the municipal journals on a report of the meeting of the American Society of Municipal Improvements. CITY GOVERNMENT is published for the purpose of providing for all city officials information of interest and value to them, and the carefully prepared papers and addresses of these national municipal conventions are considered the very best kind of information to publish for those who administer the affairs of our cities. Hence, we have spared no expense in securing prompt and complete reports of these conventions. To each national convention of the year CITY GOVERNMENT has sent from one to five representatives, and how well their work has been performed is shown by our unparalleled record of "scoops." It is a pleasure to acknowledge that our enterprise has been appreciated and rewarded by a rapidly increasing list of subscribers. CITY GOVERNMENT is to-day—and will always strive to be—"the first and best municipal journal."

The American Society of Municipal Improvements.

No matter in what sphere a man may labor• the greatest essential to success is equipment, and while many factors may enter into the equipment of a man for his work none can be of more value than knowledge. To know how to best render the service we strive to give to the world is truly the initiative to success. The cruel hand of innocence and ignorance has hindered the progress and prosperity of American cities as much as, if not more than, the profligacy of political pollution. Any society of men that has for its primary purpose the study of questions that involve the well being of the public can deserve nothing but encouragement. Therefore, the American Society of Municipal Improvements, which met last month at Washington for the unselfish purpose of disseminating knowledge on subjects that concern the public good, should be encouraged. Some of the city engineers who were present at this convention have probably been accused by their local papers of having taken a "junket," but the fact is, that every man at the meeting showed by his intense interest in the proceedings that he was there for the purpose of gaining knowledge to better equip himself for the service he is giving to the public. A great deal of knowledge was conveyed to the delegates through the papers and discussions of the convention, and those who were fortunate enough to be present surely returned to their homes better equipped for the work before them. While the objects of the American Society of Municipal Improvements are most worthy, and its work is most salutary, the attendance at its annual conventions has ever been distressingly small. At the Washington meeting only about sixty-five city officials were present. It is reasonable to presume that the society could broaden its field of usefulness by co-operating and meeting with the League of American Municipalities, an organization whose last convention brought together over 800 city officials.

Demand For Good Macadam Roads.

Progress in the construction of good roads and the growing demand for them throughout the country is evidenced by the number of States in the Union which have in late years made appropriations to be spent in experimental "object lessons" to the farmers and dwellers in the country. New York State appropriated $50,000 for this object. Of this appropriation T. Mc. C. Lentze, C. E., who is in charge of its expenditure and has under construction the Schenectady and Troy road, says in a letter: "The number of applications that have been filed for the improvement of roads is beyond expectation, and shows that the Supervisors of the various counties are fully alive to the necessity of good roads, and are anxious to take advantage of the offer of the State to pay half the cost. It would require," says Mr. Lentze, "at $10,000 a mile roughly, the large appropriation of $1,680,000 on the part of the State to cover the petitions already filed." This is a fair indication of the demand for improved roads in New York State alone, although the Legislature cannot appropriate more than $1,000,000 at a session. Massachusetts, in 1894, was given an appropriation of $300,000; in 1895 it was given $500,000; in 1896, $600,000; in 1897, $800,000, and in

1898, $400,000, all of which was expended upon roads petitioned by the various towns or counties. A total of 1,094 miles of road have been petitioned for, of which 223 miles only have been laid out and constructed. The average cost of the work done by the permanent commission in charge of this improvement has been $10,300 a standard mile of broken stone road 15 feet wide. In 1891 New Jersey passed a law granting state aid to the amount of one-third of the cost of road improvements, and the effect is already visible in the fine roads throughout the state. The opposition of the farmers throughout the state was at first very marked; of an appropriation of $20,000 in 1891, not one dollar was called for. In 1894, however, the state appropriated $75,000, and nearly the whole amount was called for, and the sums have since been increased. No finer macadam roads exist, perhaps, than in Queens County, New York, and their maintenance is nowhere equalled. The county has over 175 miles of macadam road, owns its own steam rollers, sprinkling carts and machinery, and it is stated by J. J. McLaughlin, C. E., that the system of keeping forces of men constantly at work on repairs has proved very efficient and at the same time economical.

Mileage Taxation Declared Legal.

A Chicago street railway company was given the right to lay tracks on a certain street on condition that after the expiration of a few years it would pay a yearly license fee of $500 for every mile of track operated by it. When the time came to begin paying this fee the company refused to do so. When sued for it it set up the defense that the city had no right to exact any sum, in any manner, as a condition for the use of any street by a traction company; that the defendant was denied "the equal protection of the laws," because other companies were not required to pay a mileage license fee; that if the defendant had to pay it would be deprived of property without "due process of law" and that the city could not collect revenue from traction companies except by levying taxes on their property. The case was appealed by the company to the Supreme Court, after the lower court had decided in favor of the city. The Supreme Court, as everybody expected, has done the same thing. It declares that—

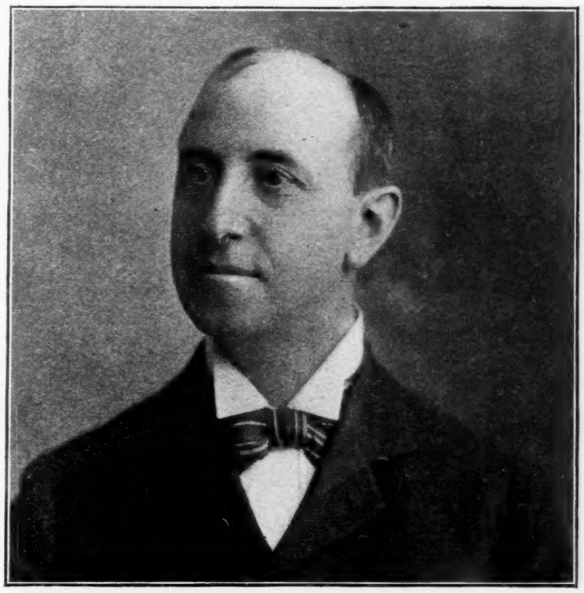
> It was clearly within the power of the council by its ordinance to make this additional condition if it so desired, and the courts cannot indulge the presumption that the act was done for an illegal purpose, it being apparent that it could be done legally. . . . It must be admitted that the defendant could only occupy the streets of the city with its tracks by the consent of the municipal authorities. That consent could be given or withheld as those authorities deemed proper, and upon such conditions as they considered for the best interests of the public they granted the privilege and named the conditions.

This is a clear, unequivocal recognition of the right of the city to exact compensation from a traction company in consideration of the use of the streets by it. That the city has that right no good lawyer has ever doubted. That compensation may take any shape that is agreed on—a percentage of the gross receipts, a mileage rental, or a lump sum. If the company which is asking for the use of a street deems the compensation which is made the condition of a grant unreasonable it is not obliged to accept the franchise. It can step on one side, and let the city make an arrangement with somebody else.

—On November 8, James D. Phelan was re-elected mayor of San Francisco by a comfortable plurality. Mr. Phelan has made probably the best mayor San Francisco ever had, and he certainly deserved the compliment of re-election. CITY GOVERNMENT congratulates both the mayor and his city.

MAYOR GEORGE R. PERRY.

George R. Perry, the democratic mayor of Grand Rapids, Mich., is a progressive man. He cares little for precedent when he considers it averse to correct action. The fact that it has always been the rule to grant street franchises in his city without exacting compensation is no argument, according to his way of thinking, why the practice should be continued.. Mayor Perry recently vetoed two thirty-year franchises, one for a street railway company and the other for an electric light, heat and power concern, because they did not provide for remuneration to the city. These two vetoes, the mayor says, were the result of what he learned at the last convention of the League of American Municipalities. In business and social life Mayor Perry is a success; he could not be anything else with his intellectual attainments, vigorous energy and charming good-fellowship.



MAYOR GEORGE R. PERRY, OF GRAND RAPIDS.

The mayor of Grand Rapids was one of the most popular delegates at the Detroit convention of the League of American Municipalities, first on account of his genial personality and next on account of his logical and ably delivered address on the regulation of the liquor traffic. In this speech the mayor displayed a thinking capacity capable of reaching fair conclusions—always the most desirable equipment for an executive officer.

POPULAR ERRORS ABOUT WATER METERS.

BY JOHN C. TRAUTWINE, JR., PHILADELPHIA.

The waterworks of Philadelphia are pumping more than twice as much water as would furnish to all its people a lavishly bountiful supply at good pressures; yet from all sides come well-founded complaints of beggarly supply and low pressure, the Bureau of Water appeals in vain, year after year, for millions of dollars for new pumps and new mains, and private companies improve the opportunity by suggesting the expenditure of many more millions for prodigious facilities which the city does not need.*

The reason is not far to seek. It is perfectly well known that more than half of all the water pumped is wasted, flowing off into the sewers without benefiting even those who waste it—or the sewers.

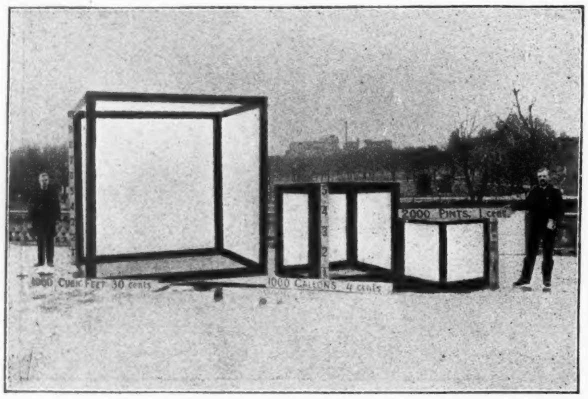
*The engineer of one of these companies said to me, triumphantly: "You know very well that the administration that puts meters on this town will cut its own head off." The engineer of another is the only engineer I know who holds that meters are unnecessary.

If the waste, or even the major part of it, were stopped, the capacity of our works would be practically doubled, and there would be plenty of water for all. The cost of installation of filter plants, or that of bringing water from a distance, would be cut in two. Even without the adoption of means for purifying the water, the quality of that furnished would at once improve, for pumping could then be stopped during seasons of muddy or coal-polluted water, and the water in the reservoirs would have longer time for sedimentation. The minimum flow of the Schuylkill would once more greatly exceed the city's maximum draft upon it, the city's annual conflict with the Schuylkill Navigation Company would be avoided, and the specter of the city's acquisition of that company's properties would be once more suppressed. Finally, the improvement and development of the supply would be brought well within the city's own means.

The restriction of waste is the key to the solution of Philadelphia's water problem.

The experience of other places leaves no doubt whatever that the proper use of the water meter is a radical cure for the evil of waste, and the only one. In other words, upon the meter depends the salvation of our city's water supply.

It is therefore most unfortunate that, through ignorance of the facts of the case, the public seems to be standing in its own light by a reluctance to sanction the increased use of meters.



WATER BY THE PINT.

[At Philadelphia meter rates—30 cents per 1,000 cubic feet, say 4 cents per 1,000 gallons, or 1 cent per ton.]

Many of our people appear to be under the impression—

1. That the proposed use of meters in dwellings is intended to restrict the use of water.
2. That the charge for water by meter is excessive.
3. That the waste is exaggerated.
4. That the wasted water helps to cleanse the sewers.

To correct the first error it ought to suffice to say that it is not desired to charge by meter for water used in families.

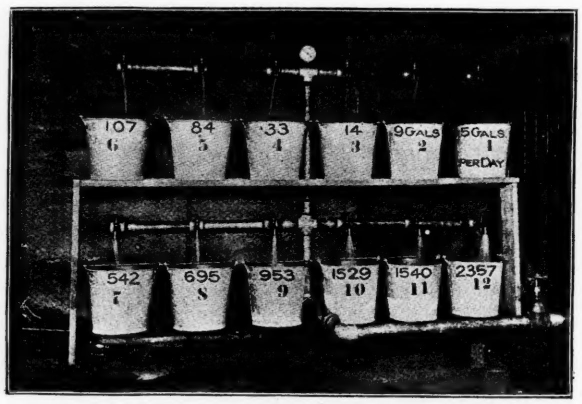
In the first place, it is not proposed to apply the meter to all dwellings, but to those only where outrageous waste is found to be going on.

In the second place, every metered supply, however little the meter shows, pays a minimum charge, established for the express purpose of discouraging economy in the use of water, and in most cases the consumer will have drawn all the water he can possibly use and enjoy, and will have done a fair amount of wasting besides, long before the meter reading equals this minimum charge. The meter thus charges only for water wasted (and not for all of that), not for water used.

There is, therefore, as a rule, no inducement to be even careful in the use of water from a metered dwelling-house supply, and this is as it should be. Otherwise undue economy might lead to filth and disease. Gas may properly be so charged as to induce care in its use, but this is not the case with water. It is better to have a gallon of water wasted than to discourage the proper use of a pint.

That the present meter rate is not excessive is shown by one of the accompanying photographs, which is simply a graphic statement of that rate. The meter rate (after the minimum charge has been exceeded) is 30 cents per 1,000 cubic feet, or about 4 cents per 1,000 gallons, or 1 cent per 2,000 pints, or 1 cent per ton. One cent's worth of water would supply from five to ten liberal baths, even if it were proposed to charge by meter for water used for baths in dwellings or for other domestic purposes.

The other photograph, showing the quantities of water wasted by leaky or open hydrants, indicates one serious source of waste. The hydrant over bucket No. 1 in this view was leaking at the rate of only one drop per second, yet it lost 5 gallons per day. The other hydrants, leaking at different rates, lost from 9 to over 2,000 gallons per day each. My bathroom faucet recently began leaking, and before it could be repaired I placed the stopper in the tub in order to measure the loss. The faucet was merely trickling, yet in the seven hours from midnight to 7 A.M. it put $4\frac{1}{2}$ inches in depth in a tub measuring 2 feet by 5 feet. This amounted to about 20 gallons, or about 70 gallons per day.



HYDRANT WASTE.

[5 to 2,000 gallons daily. No. 1 leaked about one drop per second.]

Even so trifling a leak, if it existed in each dwelling-house in the city, would amount to 6 per cent. of our total consumption, and would require an engine pumping 20,000,000 gallons a day to supply it; and it is notorious that thousands of houses have numerous leaks, in comparison with which the one in question is insignificant.

Everyone knows that it is a common thing with servants to leave a bucket under a freely running hydrant for hours in order to draw a single bucketful of water, thereby wasting many hundred times the quantity used.

An investigation of the consumption of the district bounded by Broad, Seventh, Chestnut and Spruce streets showed that 63 per cent. of the water furnished to that district was wasted, and by only 17 per cent. of the population, the other 83 per cent. paying for the wasted water.

A similar examination of a district consisting of two intermediate streets in the northwestern section of the city, where 142 seven-room houses built in 1893 were inspected, gave the following results:

Number of inhabitants	539	
Number of appliances	782	
Number of appliances leaking slightly	22	
Number of appliances turned on continually	32	
Average consumption per capita per day	222	gallons.
Water consumed during twenty-four hours	119,800	"
Water used	16,120	"
Water wasted	103,680	"

In other words, of the 222 gallons per head per day consumed, 30 gallons were used and the other 192 gallons wasted.

Here, also, a small minority was doing the wasting, and the careful majority was paying for water not received.

A correspondent recently remarked: "It is intensely aggravating to be accused of wasting something we cannot get hold of." His trouble is easy of explanation. He had simply failed to distinguish between himself and those who were robbing him of the water he paid for, and he not unnaturally jumped to the conclusion that the department was similarly oblivious to the facts. Our careful consumers, who are in a majority of about four to one, should understand that the present system makes them pay for the sins of a small but potent minority and go without the wasted water, and that the metering of the supplies of the wasteful few will rectify this glaring injustice without restricting even the wasters in their use of water.

A widow, occupying a house alone, and drawing, possibly, ten gallons per day, pays the same water rent as her next-door neighbor, who, with the same appliances, has a houseful of boarders, and who thus consumes more than a hundred times as much.

So far from restricting the use of water, the prime object of the introduction of the meter is to encourage that use by making the present supply ample.

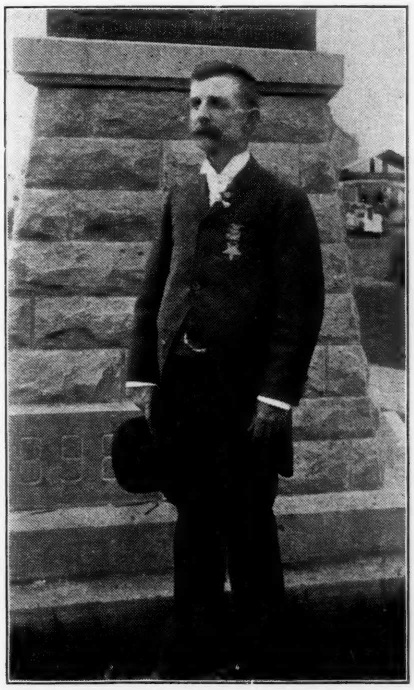
The only hardship inflicted, even upon those wasteful consumers whose supplies should be metered, would be that of seeing that their plumbing was in good order, and that no considerable quantity of water ran to absolute waste. In short, in order to keep their bills within bounds, they must take care to use most of what they draw.

As regards hardship to manufacturers, it is to be hoped that no Philadelphia manufacturer is in such straits that he would find it a hardship to pay 1 cent per ton (or but little more than bare cost) for the water supplied to him by the city; but, if it is considered advisable to give water to any or to all manufacturers at less than cost, the city can do this as well with meters as without them. The meter does not fix the rate. It simply substitutes payment by the ton in place of payment by the year. It encourages and rewards care, where the present method puts a premium on the vice of prodigality.

It is a mistake to suppose that wasted water aids in keeping our sewers clean. This water flows through the sewers with too little velocity to accomplish any good in this respect; but the use of meters would render the supply (with our present means) so ample that water could easily be spared for proper flushing of the sewers by jets introduced at high velocities.

CITY COUNCIL OF WOMEN.

In the new and blooming town of Lincoln, N. J., less than an hour's ride from New York city, the complex problems involved in the management of the municipality's business must be solved by women—for the common council is in control of the fair sex. Several years ago, when the town was founded, it was decided to have ladies take a hand in its upbuilding; therefore they have women voters and women politicians. That the feminine council of Lincoln is a body of more than ordinary ability has



SILAS D. DRAKE, MAYOR OF LINCOLN, N. J.

EMMA E. ENGEL.

FLORA P. FRENCH.

OLIVIA HAZARD.

MEMBERS OF THE COMMON COUNCIL OF LINCOLN, N. J.

been demonstrated by the intelligent and energetic manner in which public improvements have been carried on. Probably no town of similar size in the United States can surpass Lincoln in the line of local improvements, such as sewers, pavements, etc.

The councilwomen of Lincoln are intensely interested in their official work, giving it more time and study than men would ordinarily devote to it. Miss Engel, Mrs. French and Mrs. Hazard, whose portraits appear on this page, attended both conventions of the League of American Municipalities for the purpose of gleaning information on the latest and best methods of municipal service. They were accompanied by Mayor Silas D. Drake, who, by the way, is the founder of Lincoln.

RICHMOND FIRE DEPARTMENT.

The following statement concerning the fire department of Richmond, Va., was received too late to be classified with the other statistics on the subject published in this issue:

RICHMOND, VA.

Permanent Force:	
1 Chief,	$1,700.00
1 Asst. Chief,	1,100.00
1 Secretary,	780.00
1 Extra Man,	600.00
1 Supt. Fire Alarm,	1,500.00
1 Foreman Construction,	720.00
1 Lineman,	600.00
1 Lineman,	240.00
8 Engineers, $960 each,	7,680.00
8 Helpers, $840 each,	6,720.00
11 Hostlers, $840 each,	9,240.00
1 Hostler,	720.00
9 Station Men, $840 each,	7,560.00
2 Station Men, $720 each,	1,440.00
12 Hosemen, $600 each,	7,200.00
3 Tillermen, $840 each,	2,520.00
5 Laddermen, $600 each,	3,000.00
1 Ladderman,	720.00
1 Foreman,	900.00
69 Total,	$54,940.00
Call Force:	
11 Foremen, $300 each,	$3,300.00
31 Hosemen, $240 each,	7,440.00
21 Laddermen, $240 each,	5,040.00
2 Extra Men, $240 each,	480.00
65 Total,	$16,260.00
134 Grand Total,	$71,200.00

Population: Estimated 1898, 100,000.
Chief: W. G. Puller.

—The New Hampshire State Firemen's Association was organized at Manchester, on September 23, with the following officers for the first year: Chief Thomas W. Lane, of Manchester, president; Assistant Chief Frank M. Frisselle, of Manchester, secretary; J. D. Randall, of Portsmouth, treasurer; L. A. Parker, of Lancaster; P. J. Sheridan, of Claremont; Jos. Harvey, of Dover; L. A. Smith, of Nashau; F. W. Scott, of Concord; Charles W. Bean, of Franklin, vice-presidents; J. L. Brock, of Manchester; D. H. Belcher, of Raymond; W. A. King, of Concord; Earl D. Harrington, of Ashland; E. J. Sullivan, of Portsmouth, and F. W. Bond, of Manchester, executive committee.

—Martin White is again chief of police of Omaha, Neb. He was reappointed to the position on September 26.

PURIFICATION OF SEWERAGE.

(*Continued from Page 193*)

nitro-oxidation. The first takes place much quicker than the last, and the liquid during the last stage will generally take oxygen from the air quicker than the organisms take it from the liquid. The conclusion which Mr. Adeney draws is that if the first stage, viz., bacteriolysis, can be made to take place at the disposal works, then the final stage can be allowed to take place in the river or lake into which the effluent is discharged, provided these bodies of fresh water yield the necessary amount of oxygen to complete the last stage of purification. I have thought that the method of purification advocated by Mr. Adeney is worthy of great consideration, as filters in our climate may not be successful unless covered over, and then the cost of roofing would be very great and require frequent repairs. Especially would this be the case in very large works where the filters would cover many acres. The buildings at the sewage disposal works should be neat in appearance, well lighted, ventilated and provided with all modern conveniences for the employees. Garbage destroyers should be built near the disposal works, so that the heat generated may be utilized to raise steam to run the machinery of disposal works, light the works and dry the sludge where precipitation works are in use.

Before concluding this paper I would draw your attention to one very marked improvement effected by our disposal works. Formerly at the outlet of the Ferguson avenue sewer, large quantities of excreta, animal substances, orange peels, paper, rags and offensive matter imprisoned in grease were discharged from the sewer, and at times were deposited by the wind along the shore, where it became putrid and rendered the shore of the bay most offensive. Sometimes huge masses floated out into the bay and were deposited at the beach. Now this has been entirely done away with, and although we contemplated putting in filters at the Ferguson avenue works, still I believe very good work has been already done.

THE MONTAUK MULTIPHASE THERMOSTATIC ELECTRIC CABLE.

The subject of this article is one of unusual interest to fire telegraph superintendents and municipal electricians, as well as insurance officials and others interested in methods of protection from fire. There has been a wonderful amount of ingenuity displayed in the invention of devices for automatically locating and announcing an outbreak of fire. These inventions have taken the form of thermostats, which automatically close an electric circuit when the local temperature passes a certain point. The thermostats are scattered throughout a building in various places, which, in the judgment of the owner, are most likely to be visited by a fire. If the outbreak should occur immediately below a thermostat, the circuit will be closed and the alarm rung in immediately. If, however, the fire should start at a point intermediate between two thermostats, there would be more or less delay, until the temperature reached the proper degree to operate the alarm.

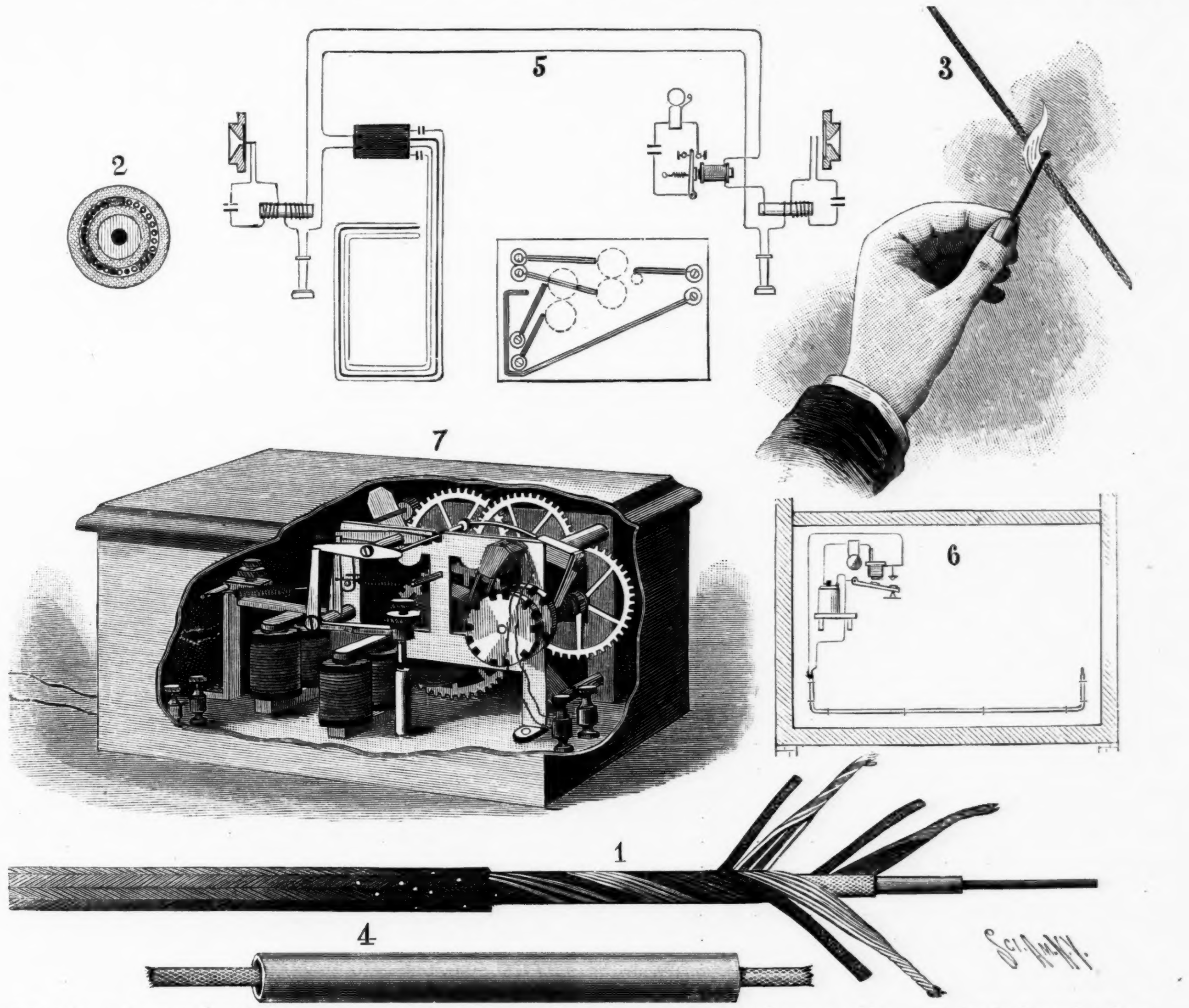
The ingenious multiphase electric cable, which we illustrate in the accompanying engravings, is the logical development of the usage of the thermostat above referred to. In place of a set of wires connecting a number of isolated thermostats, the whole wire itself is so sensitive that the mere heat of a lighted match (see Fig. 3) applied at any point of the wire will cause the metal to fuse and ring in an alarm. As the value of a fire alarm consists chiefly in the rapidity with which it will act upon the outbreak of a fire, it is evident that the efficiency of the "fire cable" is enormously increased over that of ordinary systems.

The construction of the cable and the details of the wiring are shown in the accompanying figures. The cable, Fig. 1, is made

up of an inner copper wire, which is coated with a metal that fuses at the low temperature of 374°. The fusible metal alone would serve to carry the current, but the copper is introduced to increase the conductivity. Around the fusible metal is wrapped a suitable insulation, and over this again is wrapped a series of smaller wires separately insulated, the whole being covered with an outer protective wrapping.

When a fire breaks out in the neighborhood of the wire, the heat fuses and expands the inner fusible coating and forces it out through the insulation into contact with the overlying return wire, thus forming a metallic contact between the inner and outer wire, closing the circuit and turning in an alarm. Fig. 6 shows the cable laid in a room and connecting with an audible fire alarm in the house. Fig. 5 is a diagram showing the cable ting the wires, the pliers will form a metallic connection between the inner and outer wires of the cable and close the circuit, as shown in our illustration. To avoid error in connecting up the return wires they are made in different colors. Thus, the fire alarm wires are of copper, another set are copper wires tinned, and a third will consist of alternate tinned and copper wires (see Fig. 1). To keep down the bulk of the return wires each set consists of several fine wires, whose aggregate cross-section is sufficient to make up the necessary conducting area, and they are wrapped in ribbon fashion around the insulation. Considering the nature of the cable and the duty that it performs its bulk is remarkably small.

The advantages of the cable are obvious. Not only does it provide a building with continuous lines of protection, but the



1. The cable. 2. Cross section of cable. 3. Fusing cable with a lighted match. 4. Cable in pipe for use on ships. 5. Wiring for house fire alarm connected with central fire station. 6. Wiring of room and alarm connections.

DETAILS OF THE MULTIPHASE THERMOSTATIC ELECTRIC CABLE.

connected to an automatic circuit-controller in the house or on the street, through which the alarm is automatically forwarded to the central fire station.

When the circuit is automatically closed by an outbreak of fire the current energizes the magnets in the controller (Fig. 7), which then act upon a system of small levers and release a clock mechanism. The latter serves to rotate the two controlling disks, which, by means of make and break contacts, ring up the call corresponding to the location of the fire and show the corresponding number in the annunciator. The disks are so arranged that they repeat the alarm at the central station.

A valuable feature of this cable is that it forms an effective burglar alarm; for if a burglar should attempt to destroy the ordinary window alarm by breaking the window glass and cut- sensitive wires themselves are so small as to attract no more attention than ordinary house wiring. It may be laid along the moulding, across a window or door, within the cornice, above the shelves in a store, without attracting the eye, or in any way interfering with the decorative features of the building. For detecting a fire due to spontaneous combustion in the coal bunkers or hold of a ship, the wires would be laid in pipes, which would protect them from rough usage, but leave them exposed to the action of heat. The various patents which cover this cable are owned by the Montauk Multiphase Cable Company, 100 Broadway, New York, where demonstrations of its operation can be seen. It can be used for all kinds of interior wiring, and in every case acts as a fire detector, thus performing double service.

FIRE DEPARTMENT STATISTICS.

The following statistical statements, compiled by the bureau of information of the League of American Municipalities, show the number of men, with rank or grade and salaries paid, in fire departments of leading cities. The publication of these statistics, showing a number of additional cities, was begun in the October number of CITY GOVERNMENT:

BOSTON, MASS.

1	Commissioner,	$5,000.00
1	Secretary,	2,400.00
1	Chief of Department,	3,500.00
1	First Assistant Chief,	2,400.00
1	Second Assistant Chief,	2,200.00
1	Supt. of Fire Alarms,	3,200.00
1	Asst. Supt. Fire Alarms,	2,000.00
1	Consulting Electrician,	800.00
1	Supt. Repair Shop,	2,000.00
1	Asst. Supt. Repair Shop,	1,600.00
1	Veterinary Surgeon,	2,000.00
1	Medical Examiner,	600.00
1	Purchasing Officer,	1,600.00
1	Storekeeper,	1,400.00
2	Clerks, $1,100 each,	2,200.00
1	Clerk,	1,000.00
1	Clerk,	1,500.00
1	Clerk,	1,200.00
11	District Chiefs, $2,000 each,	22,000.00
54	Captains, $1,600 each,	86,400.00
62	Lieutenants, $1,400 each,	86,800.00
43	Engineers, $1,300 each,	55,900.00
46	Asst. Engineers, $1,200 each,	55,200,00
	454 Permanent Men:	
297	at $1,200 each,	356,400.00
39	at $1,100 each,	42,900.00
52	at $1,000 each,	52,000.00
37	at $900 each,	33,300.00
29	at $720 each,	20,880.00
	92 Call Men:	
1	at $325 each,	325.00
26	at $250 each,	6,500.00
65	at $200 each,	13,000.00
1	Driver for Chief of Department,	711.75
2	Drivers for Asst. Chiefs, $638.75 each,	1,277.50
10	Drivers for Dist. Chiefs, $638.75 each,	6,387.50
2	Watchmen, $1,000 each,	2,000.00
2	Hostlers, $766.50 each,	1,533.00
	Fire Alarm Force:	
6	Operators, $1,600 each,	9,600.00
2	Asst. Operators, $1,200 each,	2,400.00
1	Foreman of Construction,	1,800.00
1	Dynamo Man,	624.00
18	Repairers, $895.79 each,	16,124.22
	Repair Shop Employees:	
1	Engineer,	939.00
1	Asst. Engineer,	900.00
1	Harness Maker,	1,252.00
2	Painters, $976.56 each,	1,953.12
2	Wheelwrights, $1,017.25 each,	2,034.50
6	Machinists, $992.21 each,	5,953.26
4	Blacksmiths, $998.47 each,	3,993.88
2	Blacksmith's Helpers, $782.50 each,	1,565.00
4	Laborers, $607.22 each,	2,428.88
849	Total,	$931,682.61

Days off with pay: One in every eight days.
Area of city: Fifty square miles.
Miles of street: 475.
Population: About 500,000.
Chief: L. P. Weber.

PENSION ROLL.

There are ninety-five pensioners, and the annual pension roll amounts to $9,818.34.

CLEVELAND, OHIO.

1	Chief,	$2,500.00
1	First Asst. Chief,	2,100.00
1	Second Asst. Chief,	1,900.00
1	Third Asst. Chief,	1,800.00
1	Fourth Asst. Chief,	1,775.00
1	Fifth Asst. Chief,	1,700.00
1	Secretary,	1,600.00
1	Supt. of Machinery,	1,300.00
1	Storekeeper,	1,020.00
1	Medical Officer,	900.00
1	Veterinary,	600.00
2	Fire Wardens, $1,140 each,	2,280.00
1	Painter,	720.00
1	Chief Operator,	1,200.00
3	Operators, $1,030 each,	3,090.00
1	Lineman,	1,030.00
35	Captains, $1,150 each,	40,250.00
32	Lieutenants, $1,030 each,	32,960.00
24	Engineers, $1,140 each,	27,360.00
24	Asst. Engineers, $1,020 each,	24,480.00
223	Firemen, $960 each,	214,080.00
7	Cadets, $900 each,	6,300.00
3	Cadets, $840 each,	2,520.00
4	Cadets, $720 each,	2,880.00
7	Substitutes, $600 each,	4,200.00
378	Total,	$380,545.00

Days off with pay: One in every five, and fourteen days' vacation every year.
Area of city: 32.41 square miles.
Miles of streets: 562.
Population: Census of 1890, 261,353; estimated, 1898, 392,000.
Chief: James W. Dickinson.

PENSION ROLL.

On the pension roll there are thirty-two retired firemen receiving from $10 to $80 per month each, twenty-five widows receiving from $5 to $25 per month each, and thirty-one children receiving from $3 to $6 per month each. The total pension roll amounts to about $30,000 per year.

DENVER, COL.

1	Chief,	$2,500.00
3	Asst. Chiefs, $1,440 each,	4,320.00
1	Secretary,	960.00
1	Asst. Secretary,	540.00
2	Fire Alarm Operators, $960 each,	1,920.00
1	Lineman,	960.00
1	Asst. Lineman,	480.00
1	Carpenter,	900.00
3	Custodians, $300 each,	900.00
14	Captains, $1,080 each,	15,120.00
14	Lieutenants, $1,080 each,	14,280.00
7	Engineers, $1,080 each,	7,560.00
7	Asst. Engineers, $1,020 each,	7,140.00
51	Regular Firemen, $960 each,	48,960.00
3	Provisional Firemen, $900 each,	2,700.00
9	Substitute Firemen, $720 each,	6,480.00
123	Total,	$119,560.00

Days off with pay: One in every eight.
Area of city: $7\frac{1}{2}$ square miles.
Population: 165,000.
Chief: W. E. Roberts.

ERIE, PA.

1	Chief,	$1,300.00
1	Asst. Chief,	1,000.00

1	Fire Dept. Electrician,	780.00
5	Engineers, $900 each,	4,500.00
14	Drivers, $720 each,	10,080.00
20	Regular Firemen, $720 each,	14,400.00
29	Call Men, $200 each,	5,800.00
5	Call Stokers, $250 each,	1,250.00
76	Total,	$39,110.00

Days off with pay: Two each month. Ten days' vacation each year.
Area of city: 7½ miles.
Population: 60,000.
Chief: John J. McMahon.

ELMIRA, N. Y.

1	Chief Engineer,	$1,500.00
1	Asst. Chief Engineer,	1,200.00
1	Captain,	900.00
6	Foremen, $840 each,	5,040.00
33	Engineers, Drivers and Hosemen, $720 each,	23,760.00
42	Total,	$32,400,00

Days off with pay: One day off in eight.
Area of city: 6 square miles.
Miles of streets: About 100.
Population: 45,000.
Chief: J. A. Campbell.

KANSAS CITY, KAN.

1	Chief,	$1,400.00
1	Asst. Chief,	1,000.00
7	Captains, $900 each,	6,300.00
7	Lieutenants, $840 each,	5,880.00
8	Drivers, $840 each,	6,720.00
1	Engineer,	900.00
1	Asst. Engineer,	840.00
8	Hosemen, $840 each,	6,720.00
3	Laddermen, $840 each,	2,520.00
5	Watchboys, $300 each,	1,500.00
42	Total,	$33,780.00

Days off with pay: Eighteen hours off every seventh day.
Area of city: 11 1-8 square miles.
Population: About 48,000.
Chief: L. H. Norman.

LOWELL, MASS.

1	Chief,	$2,000.00
4	Assistants, $400 each,	1,600.00
1	Supt. Fire Alarm,	1,200.00
1	Lineman,	936.00
14	Captains, $1,090 each,	15,288.00
2	Captains, $300 each,	600.00
6	Engineers of Steamers, $1,092 each,	6,552.00
16	Drivers, $1,001 each,	16,016.00
36	Permanent Men, $1,001 each,	36,036.00
95	Call Men, $200 each,	19,000.00
176	Total,	$99,228.00

Days off with pay: Two each month. Two weeks' vacation each year.
Area of city: 12.4 square miles.
Miles of streets: About 125.
Population: between 90,000 and 95,000.

NEW ORLEANS, LA.

1	Chief Engineer,	$3,000.00
3	Asst. Engineers, $1,800 each,	5,400.00
1	Asst. Engineer,	1,200.00
1	Asst. Engineer,	1,000.00
1	Secretary,	1,500.00
1	Dept. Physician,	1,200.00
1	Veterinary Surgeon,	540.00
1	Master Mechanic,	1,200.00
1	Clerk at Headquarters,	900.00
1	Storekeeper,	660.00
1	Messenger,	600.00
29	Captains, $900 each,	26,100.00
11	Captains, $840 each,	9,240.00
5	Captains, $720 each,	3,600.00
19	Engineers, $900 each,	17,100.00
8	Engineers, $780 each,	6,240.00
31	Drivers, $780 each,	24,180.00
11	Drivers, $720 each,	7,920.00
5	Drivers, $660 each,	3,300.00
19	Stokers, $720 each,	13,680.00
8	Stokers, $660 each,	5,280.00
69	Pipemen, $660 each,	45,540.00
24	Pipemen, $600 each,	14,400.00
18	Laddermen, $660 each,	11,880.00
12	Laddermen, $600 each,	7,200.00
4	Tillermen, $720 each,	2,880.00
3	Tillermen, $660 each,	1,980.00
7	Tankmen, $660 each,	4,620.00
5	Tankmen, $600 each,	3,000.00
1	Towerman,	660.00
302	Total,	$226,000.00

Days off with pay: Three each month.
Area of city: 207 square miles.
Miles of streets: 700.
Population: 300,000.
Chief: Thos. O'Connor.

OAKLAND, CAL.

1	Chief Engineer,	$1,800.00
1	Asst. Chief,	1,500.00
1	Foreman Chemical Engine,	900.00
11	Foremen of Companies (Call Men), $360 each,	3,960.00
6	Engineers of Steamers, $1,200 each,	7,200.00
21	Drivers, $900 each,	18,900.00
2	Tillermen, $900 each,	1,800.00
5	Stewards, $900 each,	4,500.00
39	Hosemen (Call Men), $240 each,	9,360.00
19	Hook and Laddermen (Call Men), $240 each,	4,560.00
106	Total,	$54,480.00

[NOTE: The police and fire alarm telegraph system is separate from the fire department, and employs one superintendent at $1,800 a year, one assistant at $1,200 a year and one batteryman at $822 a year.]

Days off with pay: Fifteen each year.
Area of city: 22 square miles.
Population: Census 1890, 48,682. Estimated 1898, 85,000.
Chief: N. A. Ball.

PITTSBURG, PA.

1	Chief Engineer,	$3,000.00
5	Asst. Engineers, $1,800 each,	9,000.00
1	Clerk,	1,200.00
1	Supt. Machinery,	1,500.00
2	Machinists, $1,200 each,	2,400.00
1	Veterinary Surgeon,	1,800.00
28	Captains, $1,033.32 each,	28,932.96
36	Lieutenants, $900 each,	32,400.00
27	Engineers, $1,011.10 each,	27,299.70
41	Drivers, $933.32 each,	38,266.12
203	Hosemen and Laddermen, $900 each,	182,700.00
346	Total,	$328,498.78

Days off with pay: Three each month.
Area of city: 29 square miles.

Population: Estimated 1898, 290,000.
Chief: Miles S. Humphreys.

PORTLAND, ORE.

1	Chief Engineer,	$2,000.00
1	Asst. Engineer,	1,500.00
2	Dist. Engineers, $1,500 each,	3,000.00
1	Supt. Fire Alarm Telegraph,	1,500.00
1	Asst. Supt. Fire Alarm Telegraph,	900.00
1	Secretary,	1,200.00
1	Supply Driver,	840.00
6	Company Engineers, $1,200 each,	7,200.00
6	Drivers, $840 each,	5,040.00
6	Drivers Engine Tenders, $840 each,	5,040.00
4	Hosemen Hook and Ladder Companies, $840 each,	3,360.00
4	Drivers Hook and Ladder Companies, $840 each,	3,360.00
4	Foremen Chemical Engine Companies, $840 each,	3,360.00
4	Drivers Chemical Engine Companies, $840 each,	3,360.00
4	Pipemen Chemical Engine Companies, $720 each,	2,880.00
4	Foremen Hose Companies, $840 each,	3,360.00
1	Call Foreman,	360.00
5	Drivers Hose Companies, $840 each,	4,200.00
6	Call Foreman Engine Co., $360 each,	2,160.00
92	Extra Men, $240 each,	22,080.00
154	Total,	$76,700.00

Area of city: 40 square miles.
Miles of streets: 184 4-10.
Population: Estimated 1898, 100,000.
Chief: Dav. Campbell.

SALT LAKE CITY, UTAH.

1	Chief,	$1,500.00
1	Asst. Chief,	1,080.00
1	Secretary and Operator,	960.00
4	Captains, $1,000 each,	4,000.00
2	Lieutenants, $960 each,	1,920.00
1	Electrician,	1,080.00
16	Drivers, Pipemen and Laddermen, $900 each,	14,400.00
1	Engineer,	960.00
27	Total,	$25,900.00

[NOTE.—The chief is provided with living quarters for family, heated and lighted. He also occupies the position of Inspector of Street Lighting, for which he is paid $15 per month. During their first year of service drivers, pipemen and laddermen are paid $60 per month the first four months, $65 per month the second four months, and $70 per month the third four months; thereafter the salary is $75 per month.]

Days off with pay: One in every ten.
Area of city: 51.4 square miles.
Miles of streets: 277.
Population: Estimated 1898, 65,000.
Chief: James Devine.

PENSION ROLL.

There are two pensioners, and the total annual roll is $690.

SAN FRANCISCO, CAL.

1	Chief Engineer,	$5,000.00
1	Asst. Chief Engineer,	3,600.00
4	Asst. Engineers, $2,100 each,	8,400.00
4	Acting Asst. Engineers, $1,680 each,	6,720.00
1	Secretary,	3,000.00
1	Messenger,	900.00
1	Supt. of Engines,	1,800.00
1	Asst. Supt. of Engines,	1,680.00
1	Master Machinist,	1,680.00
1	Clerk of Supply Department,	2,100.00
2	Hydrantmen, $1,080 each,	2,160.00
1	Drayman,	1,080.00
1	Watchman,	900.00
1	Carpenter,	1,200.00
1	Veterinary Surgeon,	1,800.00
34	Engineers of Eng. Cos., $1,680 each,	57,120.00
34	Drivers of Eng. Cos., $1,080 each,	36,720.00
34	Firemen of Eng. Cos., $1,080 each,	36,720.00
272	Hosemen of Eng. Cos., $420 each,	114,240.00
7	Drivers of Truck Cos., $1,080 each,	7,560.00
7	Tillermen of Truck Cos., $1,080 each,	7,560.00
7	Foremen of Truck Cos., $540 each,	3,780.00
84	Truckmen of Truck Cos., $420 each,	35,280.00
6	Engineers of Chemical Eng. Cos., $1,500 each,	9,000.00
6	Drivers of Chemical Eng. Cos., $1,080 each,	6,480.00
6	Firemen of Chemical Eng. Cos., $1,080 each,	6,480.00
6	Stewards of Chemical Eng. Cos., $960 each,	5,760.00
1	Engineer of Water Tower Co.,	1,500.00
1	Fireman of Water Tower Co.,	1,080.00
1	Driver of Water Tower Co.,	1,080.00
2	Drivers of Monitor Batteries, $1,080 each,	2,160.00
34	Foremen of Engine Cos., $540 each,	18,360.00
564	Total,	$392,900.00

[NOTE.—Foremen and hosemen and truckmen are only "call men," and can work at other occupations in conjunction with the fire departments. Clerks of companies are chosen from the members of the different companies, and receive $5 per month extra compensation for performing said duties in their respective companies.]

Days off with pay: Ten days' vacation each year.
Area of city: 42 square miles.
Miles of streets: 650.
Population: Last census, 295,000; 1898, 370,000.

PENSION ROLL.

There are thirty-three pensioners, and the total pension roll for the year is $13,560.

ST. PAUL, MINN.

1	Chief Engineer,	$3,500.00
1	First Asst. Chief,	2,000.00
1	Second Asst. Chief,	1,500.00
1	Supt. Fire Alarm Tel.,	1,300.00
1	Secretary,	1,000.00
1	Master Mechanic,	1,200.00
1	Electrical Wire Inspector,	1,000.00
8	Captains, First Grade, $1,008 each,	8,064.00
7	Captains, Second Grade, $984 each,	6,888.00
3	Captains, Third Grade, $960 each,	2,880.00
9	Lieutenants, First Grade, $888 each,	7,992.00
7	Lieutenants, Second Grade, $864 each,	6,048.00
9	Lieutenants, Third Grade, $840 each,	7,560.00
7	First Pipemen, First Grade, $828 each,	5,796.00
5	First Pipemen, Second Grade, $804 each,	4,020.00
7	First Pipemen, Third Grade, $768 each,	5,376.00
7	Second Pipemen, First Grade, $780 each,	5,460.00
6	Second Pipemen, Second Grade, $756 each,	4,536.00
3	Second Pipemen, Third Grade, $744 each,	2,232.00
6	Third Pipemen, First Grade, $756 each,	4,536.00
2	Third Pipemen, Second Grade, $720 each,	1,440.00
2	First Truckmen, First Grade, $828 each,	1,656.00
3	First Truckmen, Second Grade, $804 each,	2,412.00
2	First Truckmen, Third Grade, $768 each,	1,536.00
2	Second Truckmen, First Grade, $828 each,	1,656.00

3 Second Truckmen, Second Grade, $804 each,	2,412.00
2 Second Truckmen, Third Grade, $744 each,	1,488.00
2 Third Truckmen, First Grade, $828 each,	1,656.00
3 Third Truckmen, Second Grade, $804 each,	2,412.00
1 Third Truckman, Third Grade,	744.00
2 Fourth Truckmen, First Grade, $780 each,	1,560.00
3 Fourth Truckmen, Second Grade, $744 each,	2,232.00
1 Fourth Truckman, Third Grade,	744.00
2 Fifth Truckmen, First Grade, $780 each,	1,560.00
2 Fifth Truckmen, Second Grade, $744 each,	1,488.00
2 Sixth Truckmen, First Grade, $780 each,	1,560.00
1 Sixth Truckman, Second Grade,	744.00
1 Seventh Truckman, First Grade,	780.00
10 Engineers, First Grade, $960 each,	9,600.00
2 Engineers, Second Grade, $936 each,	1,872.00
10 Stokers, First Grade, $780 each,	7,800.00
2 Stokers, Second Grade, $744 each,	1,488.00
10 Engine Drivers, First Grade, $780 each,	7,800.00
2 Engine Drivers, Second Grade, $744 each,	1,488.00
17 Hose Drivers, $720 each,	12,240.00
2 Hook and Ladder Drivers, First Grade, $780 each,	1,560.00
5 Hook and Ladder Drivers, Second Grade, $720 each,	3,600.00
1 Blacksmith,	960.00
1 Veterinary Surgeon,	540.00
2 Linemen, $804 each,	1,608.00
1 Operator,	600.00
1 Watchman,	780.00
193 Total,	$162,904.00

Days off with pay: Four each month and seven days' vacation each year.

Area of city: 25 1-7 square miles.

Miles of streets: 790 platted and 384 graded.

Population: Census 1890, 133,000; estimated 1898, 150,000.

Chief: Hart N. Cook.

SOMERVILLE, MASS.

1 Chief Engineer,	$1,800.00
1 Asst. Chief,	600.00
5 Permanent Captains, $1,050 each,	5,250.00
2 Permanent Captains and Drivers, $1,050 each,	2,100.00
1 Call Captain,	180.00
1 Permanent Lieutenant and Driver,	1,050.00
8 Call Lieutenants, $162 each,	1,296.00
3 Enginemen of Steam Fire Engines, $1,140 each,	3,420.00
2 Asst. Enginemen of Steam Fire Engine, $1,000 each,	2,000.00
1 Asst. Engineman of Steam Fire Engine,	720.00
7 Drivers, $1,000 each,	7,000.00
1 Driver,	850.00
2 Drivers, $720 each,	1,440.00
1 Operator of Chemical,	850.00
1 Hoseman (Chemical),	720.00
42 Call Hosemen, $150 each,	6,300.00
16 Call Laddermen, $150 each,	2,400.00
95 Total,	$37,976.00

Days off with pay: One day in ten.

Area of city: 4.22 square miles.

Miles of streets: 87.6.

Population: Census of 1895, 52,200; estimated 1898, 58,000.

SEATTLE, WASH.

1 Chief,	$1,500.00
1 Asst. Chief,	1,200.00
1 Supt. Fire Alarm,	1,200.00
1 Secretary,	840.00
8 Captains, $960 each,	7,680.00
12 Lieutenants, $900 each,	10,800.00
7 Engineers, $960 each,	6,720.00
2 Pilots, $900 each,	1,800.00
1 Marine Engineer Fire Boat,	1,140.00
2 Stokers, $840 each,	1,680.00
2 Pipemen, $840 each,	1,680.00
12 Pipemen, $780 each,	9,360.00
11 Drivers, $840 each,	9,240.00
7 Drivers, $780 each,	5,460.00
10 Emergency Men, $90 each,	900.00
2 Truckmen, $840 each,	1,680.00
2 Truckmen, $780 each,	1,560.00
72 Total,	$64,440.00

[NOTE.—All stokers, truckmen, pipemen and drivers receive $65 a month the first year and $70 a month the second and each succeeding year thereafter.]

Days off with pay: From 12 M. to 6 P. M. every eight days, and from 6 P. M. to 7 A. M. every eight days. Fifteen days' vacation each year.

Area of city: 28 square miles.

Miles of streets: 115.

Population: 72,000.

Chief: G. Kellogg.

SAVANNAH, GA.

1 Fire Chief,	$2,000.00
1 Asst. Chief,	1,350.00
1 Supt. Fire Alarm Telegraph,	900.00
1 Supt. of Horses,	720.00
1 Clerk,	600.00
6 Foremen, $840 each,	5,040.00
6 Asst. Foremen, $720 each,	4,320.00
5 Engineers, $840 each,	4,200.00
16 Drivers, $720 each,	11,520.00
6 Hook and Laddermen, $720 each,	4,320.00
19 Hosemen, $720 each,	13,680.00
10 Hosemen, $660 each,	6,660.00
5 Supernumeraries, $420 each,	2,100.00
78 Total,	$57,410.00

Days off with pay: Three each month.

Area of city: 5 1-10 square miles.

Miles of streets: About 115.

Population: Census of 1890, 43,189; estimated 1898, 68,000.

Chief: John E. Maguire.

TACOMA, WASH.

1 Chief,	$1,200.00
1 Asst. Chief,	900.00
1 Night Clerk,	540.00
7 Captains, $780 each,	5,460.00
6 Lieutenants, $720 each,	4,320.00
4 Engineers, $840 each,	3,360.00
4 Stokers, $720 each,	2,880.00
12 Drivers, $720 each,	8,640.00
1 Supply Driver,	600.00
3 Hoseman, $660 each,	1,980.00
3 Laddermen, $660 each,	1,980.00
1 Tillerman,	720.00
44 Total,	$32,580.00

Days off with pay: Two each month.

Area of city: 30 square miles.

Miles of streets: About 171.
Population: Estimated 1898, 50,000.
Chief: Jesse C. Poyns.

TOPEKA, KAN.

1	Fire Marshal,	$1,500.00
1	Asst. Fire Marshal,	900.00
1	Fire Alarm Repairer,	780.00
4	Captains, $820 each,	3,280.00
3	Lieutenants, $720 each,	2,160.00
18	Drivers, Pipemen and Hook and Laddermen, $720 each,	12,960.00
1	Night Watchman,	720.00
3	Watch Boys, $60 each,	180.00
32	Total,	$22,480.00

[NOTE.—New men in the service are required to serve six months as second-class men, at rate of $600 per annum; if acceptable they are then advanced to the first class at $720 per annum. All our men (aside from the three watch boys) are now first-grade men.]

Days off with pay: Three each month.
Area of city: 6½ square miles.
Miles of streets: 118.
Population: Census of 1890, 31,007; estimated 1898, 40,000.
Fire Marshal: G. O. Wilmarth.

TROY, N. Y.

1	Chief,	$2,000.00
1	First Asst. Engineer,	1,000.00
1	Second Asst. Engineer,	1,000.00
1	Supt. Fire Alarm Telegraph,	1,500.00
1	Lineman,	720.00
1	Clerk,	1,200.00
9	Engineers, $1,020 each,	9,180.00
9	Asst. Engineers, $720 each,	6,480.00
10	Drivers, $720 each,	7,200.00
5	Hosemen, $720 each,	3,600.00
1	Supt. Hose Dept.,	900.00
1	Asst. Supt. Hose Dept.,	720.00
1	Tillerman,	720.00
1	Hoseman,	720.00
1	Janitor,	720.00
44	Total,	$37,660.00

Days off with pay: Ten days off each year and six hours every third day.
Area of city: 5.2 square miles.
Population: 70,000.
Chief: P. Byron.

WORCESTER, MASS.

1	Chief Engineer,	$2,000.00
1	Deputy Chief,	1,300.00
1	Asst. Chief,	1,100.00
1	Supt. of Fire Alarm,	1,500.00
1	Asst. Supt. of Fire Alarm,	960.00
21	Captains, $960 each,	20,160.00
10	Lieutenants, $900 each,	9,000.00
8	Call Lieutenants, $225 each,	1,800.00
6	Engineers, $960 each,	5,760.00
6	Call Asst. Engineers, $250 each,	1,500.00
28	Drivers, $900 each,	25,200.00
8	Drivers, $840 each,	6,720.00
10	Hosemen, $900 each,	9,000.00
3	Hosemen, $840 each,	2,520.00
65	Call Hosemen, $225 each,	14,625.00
7	Laddermen, $900 each,	6,300.00
1	Ladderman,	840.00
23	Call Laddermen, $225 each,	5,175.00
1	Lineman,	900.00
202	Total,	$116,360.00

Days off with pay: Three each month and ten days' vacation.
Area of city: 36 square miles.
Miles of streets: 218.
Population: Estimated 1898, 100,000.

WASHINGTON, D. C.

1	Chief,	$2,000.00
2	Asst. Chiefs, $1,200 each,	2,400.00
1	Clerk,	900.00
1	Fire Marshal,	1,000.00
20	Foremen, $1,000 each,	20,000.00
14	Engineers, $1,000 each,	14,000.00
14	Stokers, $840 each,	11,760.00
4	Tillermen, $840 each,	3,360.00
20	Drivers, $840 each,	16,800.00
132	Privates, $800 each,	105,600.00
8	Watchmen, $600 each,	4,800.00
217	Total,	$182,620.00

Days off with pay: One in six and vacation of ten days.
Area of district: 73 square miles.
Miles of streets: 255.
Population: Estimated 1898, 280,000.
Chief: Joseph Parris.

PENSION ROLL.

There are 24 pensioners and the total annual roll is $8,400.

YONKERS, N. Y.

1	Chief Engineer,	$1,500.00
1	Clerk,	500.00
2	Hook and Laddermen, $900 each,	1,800.00
2	Drivers, $900 each,	1,800.00
2	Hosemen, $900 each,	1,800.00
2	Drivers, $800 each,	1,600.00
3	Hook and Laddermen, $800 each,	2,400.00
2	Hosemen, $800 each,	1,600.00
15	Total,	$13,000.00

Days off with pay: Three each month.
Area of city: 21 square miles.
Population: Estimated, 45,000.
Chief: James J. Mulcahey.

CAMBRIDGE, MASS.

	Permanent Force:	
1	Chief,	$1,800.00
3	Captains, $1,080 each,	3,240.00
1	Lieutenant,	1,020.00
7	Engineers, $1,200 each,	8,400.00
2	Engineers, $1,020 each,	2,040.00
9	Stokers, $1,020 each,	9,180.00
19	Drivers, $1,020 each,	19,380.00
1	Driver,	920.00
1	Ladderman,	1,020.00
2	Laddermen, $920 each,	1,840.00
46	Total,	$48,840.00
	Call Force:	
2	Asst. Chiefs, $375 each,	$750.00
7	Captains, $245 each,	1,715.00
9	Lieutenants, $235 each,	2,115.00
42	Hosemen, $225 each,	9,450.00
20	Laddermen, $225 each,	4,500.00
80	Total,	$18,530.00
126	Grand Total,	$67,370.00

Days off with pay: One in fifteen and fourteen days' vacation.
Area of city: 6.75 square miles.
Miles of streets: 100.
Population: Estimated 1898, 88,000.
Chief: Thomas J. Casey.

MUNICIPAL ITEMS.

—A curfew ordinance, designed to compel children under fifteen years of age to be off the streets after 8 P.M. in winter and 9 P.M. in summer, has been adopted by the council of St. Louis, Mo.

—Mr. Leona Lemon, superintendent of the fire and police telegraph system of Baltimore, Md., has resigned to accept the position of a district superintendent for the Postal Telegraph Company. Mr. Lemon's headquarters will be at Pittsburg, Pa.

—The Municipal Club of Brooklyn devoted the evening of October 18 to the subject of police and fire protection. After visiting several of the fire houses, the members of the club inspected Brooklyn's magnificent police telegraph system. Superintendent F. C. Mason received the club and courteously explained the operation of the system.

—The League of Iowa Municipalities, which was organized at Marshalltown, elected the following officers: President, Mayor John Mac Vicar, Des Moines; vice-presidents, Mayor J. H. Redmon, Cedar Rapids; Mayor George H. Biett, Mason City; Mayor Byron V. Seevers. Oskaloosa; secretary and treasurer, Mayor F. G. Pierce, Marshalltown. The next convention will be at Des Moines.

—In Kansas City, Mo., the council has under consideration the granting of a franchise to a competing telephone company. The proposed franchise, which is acceptable to the new company, reserves 3 per cent. of the gross earnings for the city; rates are placed at $36 yearly for residence and $48 for business telephones; wires must go underground in the districts bounded by McGee, Thirteenth, Broadway and Third, St. Louis, Santa Fé, Fourteenth and Liberty streets; thirty telephones must be furnished the city free; a police and fire alarm system must be built for the city at actual cost and maintained at $6 a year for each telephone; the franchise cannot be sold or traded, at least there are provisions against either; the city can change the rates at any time by ordinance; the franchise is for thirty years.

—The Charlton street sweeper, which picks up and carries the dirt with it, was exhibited on Vanderbilt avenue, Brooklyn, recently. As the machine passed over the granite block pavement it carried off every particle of dirt and rubbish, including tin cans, long sticks, old shoes, rocks, etc. The Charlton uses no air blast or other power to pick up the dirt, but performs this important function through its left hind wheel. This wheel is much larger than the others and hollow, and the dirt is swept by the rotary broom into it. As the wheel revolves the dirt is carried into a spout leading from its top to the bed of the wagon. There is no complicated machinery about the sweeper, its simplicity of construction being one of its chief virtues. One machine, operated by two horses and a driver, will sweep from two and a half to three miles of street per day of eight hours. A circular describing the machine in detail has been issued by the Charlton Manufacturing Co., 154 Reade street, New York city.

—In his annual message, Mayor Jones, of Toledo, Ohio, advocates the establishment of a plant for manufacturing fuel gas, the control and operation by the city of the electric-lighting plant, the establishment of civil service in all departments of the municipality, the enactment of laws that will give the city such a measure of home rule as will enable it to bring out "the best that is in its own people," no grant or extension of franchises to private enterprises without the approval of the taxpayers, the abandonment of the contract system in public work, such as paving, etc., the compilation and publi-

cation of the city directory by the municipality itself, the establishment of kindergartens as a part of the public school system, a larger appropriation for street improvement, the sprinkling of the streets by the city itself, a larger appropriation for the parks, an appropriation for music for the parks, the establishment of playgrounds for the children, the establishment of public baths, improved facilities for those who trade in Toledo, the revision of the city license laws and the repeal of the ordinance licensing employment agencies in Toledo.

—The Supreme Court of Iowa has decided that the act authorizing the city council of Des Moines to levy a 2-mill tax for the purchase or erection of a water works plant is constitutional. It is held to be within the power of the council to levy the tax and to prepare a contract for submission to the voters for the purchase or erection of waterworks. The court also says that the Legislature might have authorized the council to enter into a contract for the purchase of waterworks without submitting the question to a vote. The decision says: "Many taxes are levied in advance of the contract requiring the expenditure of the money, and no one has ever called such taxes in question. If appellant's contention is sound it is clear none of these levies are valid, for the reason that those officials who are in charge of the distribution of the money may never enter into any contracts which will call for the expenditure of the money so raised. When the object for which the tax is levied is settled and fixed, and that object is found to be a proper and legitimate one, the validity of the tax is settled, and the mere fact that the money may not be immediately expended or may perhaps never be expended does not render the tax illegal; provided, of course, the money so raised cannot be used for any other purpose."